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ABSTRACT

A Congressional hearing was held at the New River Community College in Dublin, Virginia, to address the challenges of achieving quality science education in southwest Virginia. Speakers representing the subcommittee included Rick Boucher, Chairman, Subcommittee on Science; and Dr. Luther S. Williams, Assistant Director for Education and Human Resources, National Science Foundation. Statements were made by the following invited guests: Dr. Joseph Exline, Virginia State Department of Education; Frank William Taylor, Chemistry, Biology Teacher, Radford High School, Virginia; and Jack Mason, Teacher, Marion Senior High School, Virginia. Topics discussed by these speakers included the Virginia Quality Education in the Sciences and Technology program instituted to bring about systemic reform in science teaching in Virginia; the barriers to effective science teaching; and personal accounts of present practice. Additional testimony was received on the related topics by conference participants and two panel discussions. Panel participants included: Dr. Michael G. Basham, Superintendent of Schools, Scott County, Virginia; Tom Haskins, Eastman Chemical, Kingsport, Tennessee; Dale D. Long, Associate Professor of Physics, Virginia Polytechnic Institute and State University; Harvey Atkinson, Science Teacher, Rural Retreat High School, Crockett, Virginia, and Ann Benbow, Office of Pre-High School Science, American Chemical Society, Washington, D.C. Appendices include additional material submitted for the record. (MDH)

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EXCELLENCE IN SCIENCE TEACHING

ED357967

HEARING

BEFORE THE

SUBCOMMITTEE ON SCIENCE

OF THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED SECOND CONGRESS

SECOND SESSION

MAY 15, 1992

[No. 124]

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EXCELLENCE IN SCIENCE TEACHING

FRIDAY, MAY 15, 1992

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON SCIENCE,
Washington, D.C.

The Committee met, pursuant to call, at 10:30 a.m., at the New River Community College in Dublin, Virginia, Hon. Rick Boucher [Chairman of the Subcommittee] presiding.

Present: Representative Boucher.

Dr. WARREN. I am present here today on behalf of our college President, Dr. Ed Barnes, who sincerely regrets that he is unable to be here today. He had a conflict with another meeting in Richmond. Dr. Barnes, the staff, the faculty and I welcome you to our campus.

We are very pleased that you have selected New River as a location for this field hearing today, and our staff stands ready to help or assist you in any way possible. Our college always stands ready to develop an interest in and to develop support for science education for all students.

Many people associate New River Community College with our strong technology programs which prepare people for the world of work in business and industry. Today, we are strengthening these programs even more as we work with tech prep programs working with the area high schools, secondary schools and with our two local universities.

A second area that New River has developed a good record is in the area of university parallel science education. The success of New River students who take university parallel courses in biology, chemistry and geology and mathematics is evidenced in their transfer records as they continue their education at universities. Our current goal is to add physics to this list. And we are in the process of screening and hiring a physics instructor for the beginning of our next academic year.

Yesterday was a very important day to at least 400 of our students. It was graduation day. Part of the reason for the scurrying here this morning is that we did not plan on using this facility last night and we had to move the exercise indoors. And obviously, we do not have a large auditorium, as many colleges do. This is the largest. We were barely able to seat all of our graduates in this auditorium, but we used our television system and piped the ceremony out to all of our classrooms, other spaces where televisions were available on campus. I think we have 38 different places on campus where there are remote TV monitors. So the audience was scat-

tered throughout the campus watching this on television, so that was what happened last night. Our audio/visual crew has been very busy this morning wrapping up that last night and setting this up.

But one of the things I wanted to mention that was important about our graduation yesterday is that many of those students were in school because of an unemployment situation. And I would like to express my own thanks to Congressman Rick Boucher for the work that he did to help get federal funds to those students who had been displaced because of foreign competition and to acquire funds that enabled them to come back to school to continue their education. We had—I am sure we have at least 300 students now, it is probably more than that. I did not look up the statistics before I came on this morning, but it is a program that I am not sure what would have happened to these people had such an opportunity not been available.

But again, Congressman Boucher, we appreciate your support for both the college and the students in those efforts.

At this time, I would like to again welcome you to our college and to introduce you, Congressman Rick Boucher, who is Chairman of the Science Subcommittee.

[Applause.]

Mr. BOUCHER. Dr. Warren, thank you very much for providing New River Community College as the forum for this conference today and for taking some of your time this morning to come over and welcome all of us here.

I would like to join with Dr. Warren in welcoming all of you to our conference today. This is a field hearing and conference that is sponsored by the Science Subcommittee of the full Committee on Science, Space and Technology of the U.S. House of Representatives. Among other tasks, our Science Subcommittee is responsible for developing and overseeing the implementation of the federal role in improving education throughout the U.S. in the sciences and in mathematics. And so, the subject that we address here today is one that is at the core of our responsibility and our jurisdiction, and I very much want to thank all of you for taking time to come here and to inform us of your views. To let us know from the people who perhaps know the best what challenges we face, what opportunities we have and how best in molding federal policy we can meet those challenges and seize those opportunities.

Day in and day out, you confront problems and you see advantages in the U.S. system. You know what we face in southwest Virginia in terms of excellence in science education. And we very much need the benefit of those views in order properly to mold federal policy. So, I extend my thanks to you today, and by your participation in this conference, you are directly participating in the federal process for making science policy.

Our goal this morning is to give you that direct voice. And we have brought today to listen to your concerns and to listen to your recommendations the senior staff of our Science Subcommittee and also the individual in the Administration who is most directly responsible for managing on a day-to-day basis and planning for long-term implementation and change, our policy with respect to science education, and that is Dr. Luther Williams, whose title is As-

sistant Director of the National Science Foundation in charge of the Directorate on Education and Human Resources. Dr. Williams will be following me on this program and will be here throughout the day for the purpose of receiving your comments and your recommendations.

It was just three years ago now that the President convened in Charlottesville the Education Summit, drawing together the nation's governors for the purpose of looking at America's education goals for the balance of this decade. At the conclusion of that summit, the President and the governors announced a number of major goals. The fourth goal which was announced is one that I am sure all of us here today share and that is that by the year 2000, the United States will be first in the world in education in science and in mathematics.

Since becoming Chairman of the Science Subcommittee a little more than one year ago, I have developed a growing realization of the distance that we, as a country, have to travel in order to meet that goal by the year 2000. In a recent international science achievement survey that compared the performance of students in the United States and students in the balance of the developed world, we did not score as highly as one would have hoped, and the gap in our performance versus theirs was made very plain. American high school seniors who were studying advanced placement biology placed last out of 13 nations. Overall, American high school students performed below their counterparts in the nations of Japan, Taiwan, Mexico, Canada and even the developing country of Thailand.

The problem is much deeper than just declining test scores. In many of our nation's high schools, science courses are only electives, and in many instances, they are unavailable to students. Nearly 30 percent of our nation's high schools fail to offer courses in physics and nearly 17 percent fail to offer courses in chemistry. Textbooks are frequently far behind the explosion of information in scientific fields. Many children will never have the opportunity to use laboratory facilities or a computer during the course of their pre-college education. Most disturbing is the recent report that one-half of our children conclude grade seven and decide that science and mathematics are not open to them as options for continued educational growth or future potential employment.

Science teachers are also facing a number of systemic barriers that range from low salaries to working with outdated or inadequate instructional materials. Some teachers have never had a college-level course in the subjects that they are now asked to teach. Too often, science teachers are required to teach out of their fields because of local budget pressures, and those same pressures require that they have homeroom duty, bus duty and a lot of other non-instructional responsibilities, all of which taken together, detract from their ability to fully engage in the process of teaching science and teaching mathematics.

Recognition and status for science teachers are frankly too low, and I think that is something we have to address as a national problem. What do we do to enhance the status and the recognition that science teachers need and richly deserve? Opportunities for professional advancement are often lacking. At the middle school

and the secondary school level, access to teacher preparation and enhancement programs is severely limited, as is teacher access to the scientific community.

As a result of these and other problems, many teachers are simply leaving the profession. A recent report by the Office of Science and Technology Policy found that some 13 math and science teachers are leaving the profession for every new one that is added. And that is a very disturbing trend—one that we clearly have to address.

A related problem is the need to bring about greater involvement by parents in their children's education. Parents should not expect to drop off their children in kindergarten and pick them up 13 years later academically prepared to succeed in college and in the work place. And yet, one would think that is the expectation many parents have today. School reform alone will not resolve the problem of lack of preparation of K-12 students. Parents must be actively involved in the K-12 learning process, and the question of how to accomplish that is one of the issues that I hope we can spend some time addressing here today.

A very encouraging development that we will discuss at some length is the fact that just within the last month, the National Science Foundation has awarded to the State of Virginia a grant in the amount of $9.6 million so that Virginia can take part in what we call at the federal level the systemic initiative as a way to improve math and science education in public schools throughout the United States. In essence, what we are attempting to do in just a handful of states—of which Virginia is now one—is create a laboratory in which new techniques and new methods can be tried and tested to determine what really works in terms of instilling in young people a desire to excel and succeed in the math and science areas, in terms of addressing these problems that we have been talking about that are systemic in nature that confront teachers day to day in the public schools. What can we do that will make a difference? And at the end of this period of experimentation, the programs that have worked well in the public schools of those states in which these tests are going on will then be disseminated nationwide so that throughout the United States, we will have learned from that experience and the most successful initiatives can be put in place throughout the nation's public school system.

I am personally very pleased that the State of Virginia was chosen to be among a handful of states participating in these tests, and we have today from the Virginia State Department of Education Joe Exline, who also is appearing on this program and who will talk at some length about how this program will be put in place in the State of Virginia and what it is going to mean for science teachers in southwest Virginia and how you, as science teachers, can directly participate in those programs and those efforts. It is a five-year program and will involve a range of initiatives, including in-service professional development and support for science education through Virginia's telecommunications system. Plans are underway to implement the grant through ten Local Action Councils that will include our area. And we will look forward to Joe's presentation with regard to the specifics of that program and its planned implementation in Virginia.

Thirty-five years ago, the link between American science education and our nation's position in the world was vividly highlighted through the launch of the famous Soviet satellite Sputnik. While American pre-eminence in higher education in the technical areas has been well maintained—and in fact, advanced in the years since 1957—our standing in pre-college science and mathematics education has seriously diminished. Without action on our part, that trend will seriously jeopardize our economic future.

In 1957, the position in the world with which we were most concerned was of a military character. Today, that position is of an economic character. To be prepared to take place efficiently and effectively in the international economic competition with its technical overtones in the 21st Century. It is vitally important that the trends identified here be reversed and that we meet the goal of the Governors and the President of being first in the world in math and science by the year 2000. Today's high school graduates are entering the most technologically challenging environment that the world has ever known. Technical literacy is already essential for a wide range of employment, including the operation of a computer in the work place, ranging to applications such as computer controlled manufacturing processes and the operation of an automated assembly line.

We very much need your advice and your help in telling us how to mold federal policy so that these challenges can be met so that American education in the sciences is second to none. Your advice and your assistance will be extremely worthwhile and will help us make good policy for the years to come.

So, I again thank you for your participation in this hearing, in this conference. We will welcome your views. And I hope that after the conference is concluded, you will share with your colleagues in your respective schools the material presented here today. I do not intend for this conference to be the last look we take at southwest Virginia science education. We want to hear from you on a continuing basis. And what I would encourage is that you be very free to forward your comments and your recommendations to us over time so that we can have the benefit not just of your reflection today, but of your reflection and your views over the long term.

It is a pleasure to be with you. I hope that you find this conference informative, and I am sure that based upon the opinions you will express during the open forum later, we will find it informative as well.

I would now like to call on our first presenter today, who is one of the Assistant Directors of the National Science Foundation. The Foundation, as you may know, is organized into directorates that deal with various areas within the Foundation's responsibility. There is an overall Director of the Foundation, but the day-to-day operations and the long-term policy planning that is the real work of the Foundation is carried out by the Assistance Directors. And we have today the individual who is responsible for the entire Directorate on Education and Human Resources. And as such, he is the person—more than any other in the Federal Government structure—who is responsible for implementing the programs we put in place and also for helping us plan for the future.

Would you join with me in giving a welcome today to our first speaker, Dr. Luther Williams.

[Applause.]

STATEMENT OF DR. LUTHER S. WILLIAMS, ASSISTANT DIRECTOR FOR EDUCATION AND HUMAN RESOURCES, NATIONAL SCIENCE FOUNDATION

Dr. WILLIAMS. Good morning. Dr. Warren.

I am pleased to have the opportunity to be at New River Community College and participate in this hearing. I should indicate that beyond the Congressman, two other members of the group who are presenting today, I have interacted with in other contexts. Dr. Exline—to whom Congressman Boucher referred—obviously, will talk to you later about the Virginia statewide system initiative. And Mr. Taylor—a neighbor of yours—was one of the 1991 Presidential awardees in science and math education—one—I think one of the most important efforts that the Foundation undertakes.

Before my comments this morning—which broadly will be as follows in terms of categories. I want to make some general comments with respect to the status of science education in this country, vis-a-vis the international scene because that is the proper context in which the work force should be viewed. Second, talk about the overarching national issues that serve to define the National Science Foundation's agenda, then in detail, what our current programs are and what are some of the new considerations for the future.

However, before that presentation per se, I would be remiss not to make the following observation. From the vantage point of the National Science Foundation, without exaggeration or apology, one of the most important developments in recent time—certainly, from my vantage point—meaning education and human resources—was the appointment—I am not sure it is appointment—but the assumption by Congressman Boucher as the Chair of the House Science, Space and Technology Committee, specifically, the Subcommittee on Science. It has afforded, under his leadership, the Foundation with continual policy considerations that are very, very important in terms of our program design, a robust—properly so—set of attention to our current agenda, and quite frankly—and again, appropriately—challenging questions with respect to the impact. What, in fact, are we accomplishing with our programs? The question being the broad issue of accountability. And while, in fact, that has certainly revised our work schedule, Congressman, it is entirely appropriate—especially the broad issue of accountability and I wanted to broadly state it.

In fact, it seems to me that this field hearing—while it has many objectives—one obvious outcome that I hope will obtain is that it will again, after the presentations, afford us the opportunity to hear from you with respect to your perspectives on needs because that is absolutely essential to our continual attention to our agenda.

In the order that I have described, basically what I would like to do today is discuss the National Science Foundation mission in the context of what is a national—and if you will—an international

strategy. What exactly is the National Science Foundation's math, science, engineering and technology agenda? And I am simply going to abbreviate those four areas to say science education hereafter.

Our responsibility derives from the fundamental Congressionally mandated responsibility of the National Science Foundation for math and science education and human resources—the health of that enterprise. The Foundation therefore has a twin responsibility for ensuring the health of the U.S. science engineering education and providing the requisite leadership in that area.

Put in a global context, our mission today is more important than ever. As you know quite well, science and technology have a central place in our national priorities. Support for our education and research system is vital to all aspects of this country's economic welfare, leadership, and ultimately, health and quality of life.

Narrowing the question to education, leaving research aside for the moment. Clearly, support for our educational agenda is requisite to ensure that the country has a cadre on a continuing basis of excellently and appropriately trained scientists and engineers, which are the sources of continual creativity. These are the individuals that create the knowledge base that make technological innovation possible. Science education in this regard is not an elective; it is not an occasional or episodic proposition. It is a mandatory condition.

More importantly, basic high-quality science education is necessary for individuals who enter the scientific and technical work force, an example of which are the 300 or so individuals referred to by Dr. Warren, who are returning to school. That I would argue, is going to be within the context of the National Science Foundation, an area of increased interest and attention and I would argue is one of our most outstanding challenges. Specifically in the broad area of individuals who enter the educational system subscribing to science education or scientific and technical education on a limited basis after a period in the work force, which has received generally a paucity of attention. And secondly, those individuals who elect to attend community or junior or two-year institutions, and then leave the work force or more importantly—or equally as importantly—make the transition to four-year institutions.

So, I am begging the question in part with respect to hopefully what will take place in the dialogue. I acknowledge that those are two areas that require increased attention. The question is how to structure the policy and the programs and render those synergistic to everything else we are doing. But beyond scientific and technical employment per se, there is another fundamental reason, and I argue an obligatory reason why science education is so vital, and it has to do with the broad issue of literacy. Literacy—science literary—in my judgment, is not an artificially constructed addendum or add-on or supplement to an otherwise good life. Clearly, in May of 1992, citizens of this country put in the global context, science literacy certainly at a minimum level, is almost obligatory with respect to citizenship. I would argue that, in part, it becomes the dividing circumstance with respect to whether one honestly—the legal circumstances notwithstanding—one obviously has the opportunity to participate in the society. Therefore, whether people

become scientists or engineers or work in a variety of other sectors, that is an obligatory matter.

We—as the Congressman quite correctly pointed out—are facing an enormous challenge in addressing the problems in our entire educational system, but especially in the K-12. We have long-standing problems attending K-12 education, and quite frankly, the lower division of the undergraduate sector. What I mean by "the lower division" is the first two years—those generic courses in chemistry, physics, computer science, math, et cetera. It is not terribly difficult to ascertain why we have such a severe problem. I will not argue that the correlation is one to one, but most assuredly, there is a reasonable relationship between the following in recent history.

Starting in 1957—as the Congressman pointed out—there was sustained, robust, substantially upscale attention to math and science education in the country—a period of substantial reform. But in my judgment, it was an area of reform that was minus two essential components. One, there were not long-term framed goals and objectives. There were not the requisite measures to indicate whether we actually were achieving them. What did we accomplish in a decade from 1957 to 1967? And clearly, there was not the requisite accountability nor, if you will, efforts to try and assess the outcomes from the various approaches, tests, experiments—if you will—approaches that, in fact, were being introduced throughout the country. We went through a massive expenditure of resources and a whole plethora of activities, and then went into a period of comparative quiescence.

That period—basically from the early 1970s until the 1980s was a period of very, very rapid deterioration. Deterioration owing to, one, the literal explosion in the knowledge base that undergirds science, and another very, very important—not well quantitated during that era—development, and that is the changing in the broad global scene that, in fact, raised the thresholds and the expectations required of the scientific and technical work force of this country.

What we are addressing—what we have addressed in the 1980s, what we are continuing to address, is what I call the cumulative debt for that period of comparative indifference which extended in excess of a decade. So, it is from that fundamental position that we now are attempting to address a very, very severe issue. Severe in terms of all of the indicators the Congressman spoke to with respect to the number of math and science teachers not appropriately trained, both at the elementary and secondary level, a variety of other problems—the end result of which is the production of a cadre of high school graduates year after year who lack the less than exemplary set of preparations for the expectations either in the work force or at collegiate level science and engineering.

We have another problem that parallels that remarkably. Since 1960, we have been unable to find innovative and sustained methods by which we can entice an increase in the number of students who complete high school, enter college and, in fact, receive degrees in science and engineering. That number stands at roughly the same level. What I mean by that, if you take the total cadre year by year of high school graduates and ask what fraction of

those go to college and take degrees in science and engineering, two—most particularly, Bachelor degrees that track the production rate—the number of people entering that arena in 1992 is roughly equal to what it was in 1970. There has to be some correlation obviously between the deficiencies that students bring from the K-12 sector and this low level of subscription.

Based on all of these factors and looking in the—now moving to NSF programs—and looking at what, in fact, we were doing roughly two years ago, and what we were doing was the following. We obviously recognize that it is critically important to improve—for the Foundation—to have a role in improving the preparation of teachers—math and science teachers in K-12. Thus, we have—as many of you know—a major program in teacher enhancement. We also are concerned with respect to supporting the production of the next generation of K-12 math and science teachers. Thus, we have a teacher preparation program. We are interested in technology; we are interested in educational technologies—a variety of innovations in terms of curricula at all levels—assessment, et cetera. Go through the litany—basically identify essentially everything that you would imagine to be important to the enterprise, and at some level, the Foundation had a program.

But I would argue that those programs did not constitute what I would regard as a comprehensive address. Thus, we made the decision that the guiding circumstance for the National Science Foundation's efforts in science education would be as follows: All of our programs, however structured, would be designed to promote or assist in the realization of a fundamental rebuilding, starting from the bottom—meaning K—certainly to at least undergraduate school, reform of all facets of math and science education. I will now take that by broad sector.

Why did we come to that conclusion? As the Congressman indicated, the President and the Governors have laid out six educational goals with respect to being first in the world in math and science education by the year 2000. We take it as a very serious proposition. I would not suggest that achieving that goal is any more realistic than your own assessments on the matter, but it is very important that that statement was made. The aspiration that we would be first in the world and it would be achieved by the year 2000. Now, I realize, as I said, the olympian dimensions of that are problematic, meaning that we will not achieve it. But on the other hand, it would have been unrealistic, I think, for the Presidents and the Governors to say by the year 2000, U.S. students would be—what?—sixth in the world. So, that—why not one in the world.

But the real factor is that it sets a challenge for all agencies—the National Science Foundation included—and the requisite policy decisions that follow therefrom. Not only are we to be first in the world, there is an additional stipulation that deals with the issue that I think is obligatory, and that is the matter of accountability, meaning that we have to sequentially measure our progress toward the achievement of that goal, starting in grade 4, then grade 8, then grade 12. And we have to report that through the National Educational Goals Panels to the nation. It has a responsibility of making a report to the nation on achievements of all the educa-

tional goals—in our case, the one that deals with math and science education.

Secondly, there has evolved the America 2000 strategy that encompasses all facets of schools—restructuring schools, but probably the most important component of it essentially disallows the status quo. The extent to which the Foundation's programs are consistent with that is another very, very important consideration.

The third major development that I would argue that is critical to our agenda is the realization that our programs and our enthusiasm about those notwithstanding, it would seem to me that no single entity—the National Science Foundation included or the State of Virginia, for that matter—taken in isolation brings to bear the requisite intellectual, programmatic and financial resources for a comprehensive address of this very, very serious problem, meaning K-12 science education.

And even if that were the case, it seems to me all relevant logic would obligate the formation of partnerships and collaborations among all of the players. So, one of the things that we are increasingly doing is collaborating with other federal agencies through a White House structured committee, but also as represented by the Statewide Systemic Initiative. That, in effect, is a collaboration between the National Science Foundation and the State of Virginia, and in fact, the other states.

Well, what are we doing programmatically in general terms? Let me start with the graduate sector—about which I will say very little—and move to the K-12.

Obviously, we have a responsibility for producing scientists and engineers, period, at the graduate level. The principal mechanism for doing so has been the NSF Graduate Fellowship program. Incidentally, all of the programs to which I would allude are in the brochure that was made available to you at the registration desk. We have over the last five years doubled the level of that program from 1000—I am sorry—from 500 to better than 1000 students per year, giving specific attention to students—graduate science and engineering students who are under-represented in the enterprise.

We have also recently initiated—ones of you who are from the University sector would find of interest—a graduate traineeship program in science and engineering. And this is the program in which the institution—not the Foundation—in effect, defines the elements of the program peculiar to that institution's interest and provides quality education in science and engineering.

The last comment with respect to this enterprise is that I think by any sensible, reasonable definition, this country probably has the finest graduate education in science and engineering and research enterprise in the world. The problem is not taking it in isolation as it is as exemplary as my statement would suggest. The question is, what it can actually contribute to other sectors—particularly in terms of research—substantive research that would allow us to advance the knowledge base with respect to how to do a better job in the K-12 sector.

For example, we clearly need to extend our understanding of how students learn science and mathematics at the elementary level, at the middle school level, at the high school level. Students have different learning styles, as you know well. The educational

or the instructional methodologies or techniques that bring to bear on that should seek to match with those requisite learning styles. The parallel of that in terms of a major research agenda is that we need to acquire a better knowledge base or understanding of strategies with respect to teaching science and mathematics. So, both teaching and learning science and mathematics are an important activity. To the undergraduate level—undergraduate including both two- and four-year institutions. And before I proceed further, it is only in recent times that the Foundation has given attention to the two-year college sector. However, for all of the reasons I indicated—the increased need for the Foundation to be a major player with respect to revitalizing the training and preparation and technical skills of the work force, but also making provisions for quality lower division instruction in science in order that students can move successfully to the next educational level. It is obligational that we assign increased priority to this area. The Congress—Congressman Boucher included—certainly has made sure that the Foundation seriously takes up our responsibility in this broad area.

But generally, in the undergraduate area, we are doing three things. One is that we have a major program designed to revise individual courses and curricula at the undergraduate level, focusing primarily on introductory courses. And here is an agenda that would be entirely consistent with the two-year college sector—general chemistry, general physics, math, et cetera. Not only do we support that; we also are supporting a comprehensive address of curricula in science and engineering—the entire curriculum, not individual courses—calculus—a course which we have been supporting for years, from the point of view of reform has now encompassed all of mathematics. We are supporting projects that look at the entire scope of engineering education, et cetera.

The second area of interest has to do with improving the capabilities of colleges and universities with respect to laboratories, and we do this primarily through a program called Instrumentation and Laboratory Improvement, where we provide the funds to an institution to, in effect, bring to bear modern equipment or instrumentation in science and mathematics instruction. We have made in excess of 7000 grants to individual projects and colleges and universities throughout the country over the last five years under this program.

Like the laboratory—like revising the courses or the individual curriculum, there's a critical issue in my view that deals with the faculty that work in the two-year college sector, as well as the four-year college sector. So, we have a program called Faculty Enhancement, under which we are seeking to provide opportunities—primarily through workshops and short courses—to the faculty in the summer often, of colleges and universities who have major instructional responsibilities at the lower division level to ensure that there is continual improvement of the skills and preparation of those faculties.

So to summarize, the undergraduate agenda addresses improving the skills and preparation of faculty members, providing resources to revise, innovate courses and curricula, individual or the total laboratory improvement and instrumentation for the laboratory.

And the last activity in that area has to do with providing research experiences for undergraduates.

Within the context of a nearly $500 million budget for the current fiscal year for education and human resources at the Foundation, by any definition, our largest activity is in the pre-college or K-12 sector. I would like to spend the rest of the time speaking about it. What are we doing in that broad area?

First of all, it seems to me that overarching our entire science education effort in the K-12 sector should be general attention to broad issues that will afford increased knowledge and increased understanding of the entire enterprise. That is, we are looking at—we are supporting the development of standards—science standards—to complement the mathematic standards developed by the National Council of Teachers of Mathematics. Standards that speak to the curriculum, that speak to teachers who are employed and speak to the assessment that should follow therefrom.

We are also supporting the development in broad context of a variety of studies, including the American Association for the Advancement of Science's Project 2061. So, studies that broadly look at the status of K-12 education—science education in the country, specific programs, and then, talks broadly to the issue of standards. It is in that broad context that we then frame all of our programs.

The program that I would—that probably next that should receive attention is the broad rubric of curricula, instructional materials and assessment that relates to it. What we have in place is the following comprehensive program, in chronological order. A major curriculum or instructional materials effort that is targeted toward K-6 science education that looks at all facets of it and takes the majority of our support. Informed by, on a conceptual basis, a programmatic basis, of what is done in K-6 education, we then support curriculum and instructional material development in essentially middle grades or middle school. That becomes science and mathematics. And then lastly, we support science and math courses, instructional materials at the high school level.

So, as an organized continuum, to give you some indication of the level of effort, that is almost a $90 million enterprise for the current fiscal year. Our view is that if one has first of all decided on the broad reform issues that are important, then we need to be terribly innovative in terms of material development, produce multiple examples of it that are broadly disseminated and used by school systems, and they are asked to do assessments of the relative utility of the material. The overall goal, obviously, is not to make an art form out of instructional material development. The idea is to have enough models and enough approaches that after a period of experimentation, a period of use, we—in collaboration with you—can come to a general consensus that probably for most elementary level students, K-6, these five curricula units or instructional materials are the most optimal ones or they work exceedingly well and we do not have to continue to support the other 15.

Same questions at the middle grade level. Time and experience and performance of students and the experience of teachers indicate that these X number are probably the most exemplary middle school science and math instructional materials. And the same set of issues at the high school level. So as a country, we develop essen-

tially a database of those instructional material units that are shown to be most efficacious. Obviously then, our challenge is to continue to update them, revise them and sustain them into the future.

But we have not reached the point yet of being able to catalog the most effective ones; thus, we are approaching the issue in terms of support from multiple perspectives with and without computers. Obviously, almost all of the curricula approach from a constructionist or hands-on perspective with respect to students' involvement.

The next broad area is obviously one that has dealt with instructional materials of the math—of the instructional work force. As I indicated earlier, we have a major effort to improve the preparation of teachers who are currently in the work force and who have responsibility for math and science education. And it again is done by three sectors: elementary science teachers or elementary teachers obviously with science instructional responsibility; middle school math and science teachers; and then finally, high school math and science teachers.

We set the goal a couple of years ago as one agency of assuming responsibility for supporting the enhancement of roughly 12-1/2 percent of the total instructional work force, and if you—depending on how one does the numbers, I am talking about 2 million individuals. We have been able to double in two fiscal years the number of teachers that the Foundation's programs serve, from about 11,000 to now roughly 25,000 teachers, and we have a long-term plan which we hope that ultimately on a fiscal-year-by-fiscal-year basis, the Foundation's programs will be reaching 60,000 math and science teachers throughout the K-6, middle school, high school continuum, with greatest emphasis—because in our view, it is probably the area of greatest need—placed in elementary level teachers, followed by middle school and less attention on those in high school. Another issue obviously has to do with producing the next generation of teachers. We are accomplishing this through a series of teacher preparation grants in science that we make to colleges and universities. But we recently made a major change in that program, and that is to ask the grantees to couple producing the next generation of teachers to actually providing in-service preparation for those who are already in the work force, but also, in effect, providing teacher preparation in an enhanced experimental mode. And what I mean by that is that it has to engage the participation of teachers—science teachers from the local school system. So that the preparation has, if you will, a different level of reality tests. And I do not mean that this is a substitute for traditional teacher training or practice teaching or staff development, but a process by which professionals—teachers, science teachers from the K-12 sector, actually have some role in the preparation.

In addition, the idea is to try and structure this program such that the preparation is sufficiently substantial with respect to disciplinary areas—science areas, biology, chemistry, physics, et cetera, that we minimize the need for the rather fundamental kind of effort that is currently taking place in some of our teacher enhancement programs. I am not complaining about that; I am simply observing that as you know well, certainly at the elementa-

ry level, if we are providing enhancements for teachers—many of whom had very little fundamental science training as a part of their initial preparation, it is a more substantial enterprise. It seems to me that the Foundation could take up the responsibility of making a distinction between these two programs. Said another way, it seems to me, if we are going to support teacher preparation efforts in a substantial fashion, we should try to ensure that it is substantial enough and rigorous enough that those teachers would not almost immediately require enhancement upon entering the work force. So, a broad area in terms of teachers after following curriculum and instructional materials.

But what of the students who are already in the school system while we are trying to promote this long-term and sustained reform. It seems to me, obviously, it would be important to provide the opportunity for select numbers of youngsters to have augmentation or supplementation of their math and science experiences currently, last year, this year. Thus, we developed a program called Young Scholars. It is a program that actually can start at grade 7, but typically, they are grades 9-11. In school systems working with local colleges and universities, the program that I think would be ideal for a college such as this—and there is an analog—there is another community college in this state that has one of these programs. And what, in effect, it does during the summer primarily is to provide a very rigorous and intent exercise in science education to a collection of middle school and high school students. That program has grown substantially over the last decade. We have served probably in excess of 50,000 students, and the current level of support allows us to serve in excess of 7000 students nationwide, and there are five—as I alluded to earlier—such grants in the State of Virginia.

Again, students focus efforts within the study. The state arena has to do with students who are under-represented in the enterprise. And we have developed through a series of comprehensive centers similar student focus programs that deal with minority students on the one hand and girls on the other. All of those—those three programs are designed to achieve exactly the same thing. While we are promoting major reform from overall standards to instructional materials, to enhancing the preparation of the next generation of teachers or doing it in a different fashion, to improving the skills and preparation of the teachers who are already in the work force, what of the students with interest and with motivation who are already in the system. The idea is to have a program that will extract, if you will, during the summer a significant number of those youngsters and provide for them a substantially intense intellectually demanding experience in order to ensure that they are better prepared for the collegiate level of science and engineering efforts.

We are also supporting the presidential awards program. And just briefly, that is just an effort within local school systems and states to acknowledge math and science teachers, elementary and secondary level, who have obviously accomplished much and who can serve a leadership role within the state and assist us, if you will, in more broadly disseminating the agenda.

But all of these efforts—to which I could add educational technology, a major effort in assessment, researching, teaching and learning—a variety of strategies, the largest being those that are focused on teachers and instructional materials and the requisite resources needed in order to implement in the classroom those math and science curricula. There are other efforts of a secondary nature that support them.

Increasingly, educational technologies that particularly try to find a way to—within a state, within several school districts—to magnify the effect of one or more exemplary programs through the use of telecommunications is emerging as one of the highest priorities.

But beyond these categorical programs—this is basically the last point I want to make—in early 1991, we came to the view that basically what I have gone through—teachers, curriculum, educational technologies, intensive programs for students, involving the corporate sector as partners, parents—which I had not talked about earlier—all of these players and programs—equal—looked at for one point of view—a set of variables.

Let me explain it in the following way. If you desire to improve the quality of science instruction for an eighth grader and you were able to identify a finite set of resources and activities, what would you do? Well, you do many things, but I would suggest that the more optimal effort would be the following:

In real time, simultaneously bring to bear on that eighth grader the best—the most reasonable curricula taught by the most competent teacher with the benefit of the best instrumentation to support the instructional effort, with the benefit of the very best technology, with informal or out-of-the-school experiences, informal science experiences at the local museum or the science centers and et cetera. In other words, all of the factors that in the aggregate in real time would make the most difference in terms of impacting that eighth grade student's learning of science.

We, therefore, initiated the program called the Statewide Systemic Initiative statewide because the primacy for it resides in the state. Statewide is because we want to challenge the grantees to give attention to all school systems throughout the state, not selective ones. Systemic by the definition that it should, in fact, encompass all of these variables—all of these programmatic indices to which I spoke. And comprehensive in the sense that it should be—if not all of K-12, the minimum we accept is that it should be at least K-8, for the rather obvious reasons. The assumption is that if one cannot do everything, then primacy should be assigned to elementary, to the middle school sector.

States in response to the Foundation commit themselves to deal with all of those elements, as I indicated. And as the Congressman stated, in 1991, we made a series of awards to ten states. We have just made ten others—eleven others, including the State of Virginia. And I otherwise would describe it, but Dr. Exline will do so. The goal is precisely as was indicated by Congressman Boucher. We have now in 21 states these major experiments underway. They involve the National Science Foundation resources; they involve resources from the U.S. Department of Education. They will involve other federal agencies, state resources, local resources, but impor-

tantly, funds from the corporate and business community. Because I would argue that now individual states—the State of Virginia, for example—have put together a comprehensive, explicit, highly articulated plan by which it hopes to promote substantial K-12 reform of science education.

There is a role, therefore, to be played by all of the major players in the State of Virginia—whether they are in the school systems per se—and particularly in the corporate or business community. It allows those individuals—in particular, those organizations to make an important transition. Clearly, you know, as well as I, the business community has made contributions and have been involved in a system in K-12 education—science education—for some time. My view is that this program provides sufficient structure that those businesses now can translate what I would otherwise call contributions into investments, meaning that there is a highly articulated niche to which everyone else has agreed is going to be the agenda for the state to which, against which or in which they can actually make their investments and have—with the requisite accountability.

Increasingly, in terms of the future, the Statewide Systemic Initiative—at least as a strategy—is representative of the kind of approaches that we will take. We will take the approach because we have the benefit of increased knowledge of how teaching and learning takes place in terms of science. We have the benefit of the outcomes from a variety of reform efforts, like 2061, that lays out conceptually what it is that is reasonable for a student to learn in science during the K-12 sector. Said another way, if you have some sense of what it is that is reasonable for a student to learn, one can make some relationship between the instruction that takes place in grade 3 and what does that have to do with what is going to happen in grade 7 and what does it have—the two of those have to do with what is going to happen in grade 11.

We also, as I said earlier, now have in place this major commitment to deal with pre-service and in-service teachers. The various curricula models, educational technologies are underway. We are beginning to make increased linkages between the K-12 and the undergraduate sector, including two-year institutions, and addressing the needs—albeit in the early stages of it—of those individuals who are displaced in the work force as critical human resource development efforts and giving specific attention to individuals otherwise under-represented in the enterprise.

It, therefore, seems to me that it is possible now—while not disallowing categorical efforts—meaning modest-size projects that focus on specific populations or specific needs or specific programmatic niches, it is possible to try and promote a program—a set of programs that actually, by their substantiality and by their scope—match the overall reform effort.

One of the rather laudatory components of making that transition from what I call categorical to more global programs, it is the changes—the threshold for everyone—that changes the level of accountability. Clearly, with multiple players, they obviously critique each other. Clearly, with this long-term partnership of collaboration, it is not up to the National Science Foundation to simply make an award to the State of Virginia and give our attention to

something else. We have a sustained responsibility over the initial five-year duration of the award to continue to collaborate with the state—to be a partner in the conduct of that experiment and the other 20 that are taking place around the country.

Therefore, the likelihood is very good that at the end of this exercise—whether five years or longer than that, but when we decide we have reached the point when it is important to actually take a measure of what we have accomplished in the aggregate because we are going to measure it each year, to then try to learn from the 21 major tests that are taking place throughout the country what number most recommend themselves for adoption throughout the country. It seems to me ultimately, that summary statement, with respect to this one program, should be the summary statement for reform of science education throughout the country—K-12 and where necessary, at the undergraduate level.

We are into an era in which despite enormous excitement and enthusiasm about our agenda, it would be nothing short of a travesty if at the end of the math and science education reform movement effort of the 1980s and 1990s, as we reach the year 2000, it ends without our knowing with requisite explicitness what we have done, why, what were the outcomes and what truly works programmatically and why it works. And therefore—if we are able to answer all of those questions, the country is therefore able to enter the 21st century with respect to science education armed with a knowledge base, an exemplary set of programs that will bode well for its future in science education.

Thank you.

[Applause.]

Mr. BOUCHER. Luther, thank you very much for your attendance here and for those very informative remarks about the activities of your Directorate within the National Science Foundation.

I probably should have said this during the course of introducing Luther, but it occurred to me as he was talking that there might be some who are not familiar with what the National Science Foundation is. It was called, from my memory, that one of the other associate directors of the Foundation, when he was in my office earlier this year, said that because of the title of this body—it is called a "foundation"—some people have the sense that it is not an agency of Federal Government, that perhaps it is a private foundation that simply has science advancement as its goal. That is not the case. It is a federal agency. In fact, it is the primary federal agency that has science advancement as its mission. It has a budget of $3 billion each year devoted to that goal. And it is the principal funder of basic research at the nation's colleges and universities, as well as encouraging education in the sciences and mathematics in our public schools.

This one particular fellow who had related that to me said that when he went from the State Department, where he had previously been employed, over to the National Science Foundation, the Office of Personnel Management within the Federal Government actually sent him a form asking if he wanted to withdraw his retirement contributions in view of the fact that he had gone into the private sector. Obviously, there was some confusion—at least in those quarters—as to whether or not this was an agency of government. Well,

it very clearly is, and Luther, we appreciate your being with us today.

As was indicated earlier, the State of Virginia has now received $9.6 million in federal funds from the Foundation. That award was made on the 1st of May of this year, so that Virginia could be a participant in the statewide systemic initiative. That initiative will have implications for science and mathematics education throughout the State of Virginia, including here in southwest Virginia. And to talk with us about what those implications are and how you can be participating in that initiative, we would welcome next Mr. Joseph D. Exline, who is the lead science specialist for the Virginia State Department of Education and whose task it will be to implement that initiative in Virginia.

Joe, we welcome you today.

STATEMENT OF DR. JOSEPH EXLINE, VIRGINIA STATE DEPARTMENT OF EDUCATION

Dr. EXLINE. Thank you, Congressman, for giving us some time on your program.

Dr. Williams, the Governor and the Secretary of Education and the Superintendent of Public Instruction, are very pleased that you have entrusted us with one of your models, and we will do our best to make sure that this becomes a very important model throughout the country. We are very much committed to it.

I have a—I had a couple of transparencies I am going to use to explain this, but this distinguished panel, I would be afraid to pull that screen down in front of them. So, what I might just try to do is walk through this.

I have some handouts down here that I would like you all to get. There is a handout on the systemic grant and there are some transparencies here which I was going to use.

But, let me kind of walk you through what we are trying to do with the systemic reform in Virginia. We call this VQEST, which stands for Virginia Quality Education in the Sciences and Technology. We have already come up with a logo for that, which we hope you will see throughout the state very quickly because we feel very—very much that this is going to convey quality, and we are going to also—we believe that the systemic reform in mathematics and science has to impact beyond just mathematics and science. We have to create an environment for learning, and that is the focus of the Virginia Quality Education in the Sciences and Technology, or VQEST, as I will now refer to it.

You have heard of world class education throughout this country. You have heard of a common core of learning, and we are a portion of that. The way that we are going to implement a world class educational system if we are going to produce a work force which is competent to move us into next year, and then into the 21st century, we are going to have to create an environment that is quite different from the environment we have now in schools. We are going to have to create an environment that will help dedicated teachers to do a better job. Teachers have held a poor system together for a long period time, so we have got to build that system

that will help support those kinds of good efforts that we have been trying to implement for a long period of time.

What we have taken the definition of scientific literacy to be—and we know that you have got a—you are funding a national committee now to come up with some standards. But, I believe and I will be challenged—you can challenge me later on this—but I believe there will be four important ingredients in that—in those standards as far as student achievement. Students will need to develop skills—skills that they can use beyond the classroom; skills that are useful in the real world. Students will also—should nurture attitudes—attitudes to take action, attitudes—and in our case, scientific attitude—respect for data, demand for verification.

Students will also have to see connections across the discipline. They will have to see—we talk about—there is a lot of talk now about the integration of the disciplines. Well, we do not even have integrated science programs throughout the country. There are little boxes of chemistry, physics, biology. So, it is very important that we do make appropriate connections—appropriate connections that will make science, biology and chemistry and physics fit together, but it will also interrelate that to the other disciplines, and more importantly, to the real world. We do not learn science just for the classroom; it has to have application. And how do you do that? You have disciplines that you work in. But these disciplines—biology, chemistry, physics—will make the connections to large themes or overarching themes. We are looking at change, inter-relationships in science. We are also looking at change in inter-relationships in the social world. So those are the connectors.

And then, of course, we deal with scientific values, such as respect for data demand for verification, suspension of judgment. And then, the skills of problem solving. And so, if we take those as goals, and then, we have to develop a system that will support those goals.

When President John Kennedy said in 1960 at the beginning of that—the era of 1960s that we are going to put a human on the moon and return them safely, that was a goal. That was a realistic goal. It would have been unrealistic to say that, we are going to put a human on Mars and return, because that was not realistic at the time. So, they did not change the goal and he did not say well, we cannot get to the moon; maybe we could go to the top of Mt. Everest. The goal remained the same. And what they did then was to build a system that would get them to the moon and back safely.

And so, we have to set realistic goals for all of our students and not just for a special group of students for mathematics and science. So, that is what we have done, and this handout that you will get a little later, we have those identified in there. But essentially, it is summarizing those four things.

But now, after having said that, that is the easy part. And we tend to—we compare ourselves to the Japanese; we compare ourselves to the Germans. And they seem to be doing better than we are on the basis of those student tests. But what we need to look at is what is different in those systems? What is different in the environment? If that is true, why are they doing better? So we need to look at elements in the environment.

And we are looking at—in the VQEST effort, we are looking at six very important things. We are looking at teacher preparation, and there are two components of that. We know that there needs to be a lot of work done in the area of elementary. So, over the next five years, we are proposing to put an elementary specialist in each of our elementary schools throughout the state, and that will be a specialist that will work with math and science, that will teach math and science, but also will work with other teachers. And we want to connect those people with technology so that they can communicate with each other across the state—the schools can communicate, and that is part of our business/industry contribution.

Dr. Williams, I think, indicated that this is only a small portion of the money we need to get this job done. This is just seed corn. And so, what we have to do is expand that money, and part of that—there is a type of expansion—we already began to talk with business and industry about it.

Another very important part of teacher preparation is the fact that we are going to be working with universities, so ours does extend a little bit beyond K-12. And one of the things we are going to be looking at at the universities is the academic departments in universities. And I kind of smile when I say that because someone has asked me do you have rocks in your head, that you think that you can bring about changes in the university system, and we think that, yes, we can. In fact, Dr. Carrier from James Madison University has been working with us. He met with us yesterday afternoon. And they are already beginning to look at the way they teach science—not science education courses, but science.

So what we would like to do is to go into the—to fund a couple of three models that we can get the way that the 100 level and the 200 level courses are taught differently at the university level because that will address three very important issues. It will address the pipeline issue of the individuals going into the engineering field and into science fields and mathematic fields. And some of the statistics show that 50 percent of freshmen that enter college intent on majoring in science and mathematics drop out at the end of the first year. That may be partly because they are secondary and elementary programs; but it may be also a part of the result of what happens to the university. So we can encourage more people to go into science, and then, in liberal arts, where our Congressmen and people, to get their experience of science, we want good science courses so that they will also see the relevance of science and mathematics in this society. And then, of course, our elementary and our secondary teachers will also need to be exposed to better courses at that particular level. And that is where they go through their first-level courses. So that is another—that is a second prong of this VQEST.

A third area of VQEST is to talk—is to put—not to talk, but to put some things in place where we can work with administrators. Administrators have to see their role differently in how they go about administering a program so that we will have mathematics and science taught, and very importantly—it is considered very important in our subjects within the school, and it will be connected to the other discipline. So we are going to have—begin work with

administrators, in-service training for administrators. We will have school boards and people like that involved. They are decision-makers.

And a fourth—and I think that Dr. Williams mentioned this a couple of times this morning in his talk—the instructional materials. Textbooks, software, video disks—all of those things being produced—have to be in line with our goals. And if they are not in line with our goals, they tend to take us off in a different direction. In that regard, we have already started to work with eight or nine other states that are very much interested in helping to send a message to the publishers that we need different kinds of materials to fit our goals that we have for students. We have had two conferences in Virginia already dealing with that issue, and the last conference we had was on March 20. We had all of the major publishers there. We had eight other states with us. We had people coming from as far away as California and Canada to be with us. National Geographic was there. And they were very much interested in seeing how we can work together to develop better instructional materials based on the goals we have for students. So I am very excited about that particular phase of our VQEST.

And another very important part of VQEST is the community action groups. And that is where we will get large, widespread involvement not telling you, but you are feeding up information up to the state level in the way we restructure science and mathematics. We will have at least ten regions where we will begin to form coalitions with government, coalitions—local government, that is—local businesses, teachers, administrators, PTAs, Boy Scouts, Girl Scouts—all of those groups that can somehow impact on changing the way that we think about mathematics and science because parents are going to have to be supportive of our efforts, and we are not—part of what we want to do with our VQEST effort is to begin to rethink some of the ways we are spending current resources. We know we will need some new resources, but I think some of our current resources are going probably in directions that are not too supportive of some of our overarching goals.

And then, a—a sixth component of VQEST is technology. And we are going to look at ways that we can use technology more effectively; we are looking at ways that we can deliver it to teacher in-service via satellite. Rather than have teachers go to college campuses, perhaps we can beam these programs out to teachers. How we can put teachers in touch with resource people at the universities and research institutions and so on and put teachers and students in contact with other teachers and students across the state.

So we are going to look at different aspects of the use of technology. And our schools are technology poor. If you look at other aspects of society, we look way back in the 18th century. If you look at modern communications, modern medicine, modern transportation, those things have changed drastically. But modern education is still relying a lot on the chalkboard and a lot on the straight rows of chairs and so on. So we are trying to convert that through a systemic look at the whole school picture and trying—school and community, I should say—because we have to reach outside the school and get the community involved. So these are kinds of things that we are looking at in terms of our VQEST efforts, and

as I said, I think the people in this country are going to look very carefully at what we are doing. And we want to be held accountable for our goals because if we are not held accountable, that puts some pressure on us here at the local level to make sure that these things are achieved. We are very serious about it. We have got the right structure in place; we have got the General Assembly people behind it. We have got the Governor's Office behind it. But importantly, we are getting a lot of the grassroots people behind it. We have had this in place working toward this grant, but we have got a team of about 180 people across this state already working. We have got people from VPI, University of Virginia. We have got public television stations with us. We have got the state PTA president working with us. So we have got a lot of people working with us on this effort.

So, I would be—again, I am glad to be here this morning to give you just a brief overview on this. But if you have any questions, I am going to be around. And I would like you to get a copy of each of these handouts before you leave sometime today.

[Applause.]

Mr. BOUCHER. Joe, thank you very much. I appreciate your coming out from Richmond to join us here and give us information on how the systemic initiative will be implemented in Virginia and particularly how we in southwest Virginia can take part.

For the balance of the day, we will do what I view as the most important function today, and that is, hear from you. We will have an open forum that will begin with remarks by one of the professors—teachers in southwest Virginia who has been nationally recognized for his work, and that is Mr. Frank Taylor, who was one of the 1991 Presidential Award winners for excellence in science and mathematics teaching. He is a teacher at Radford High School—has been since 1984. His field is biology and I believe also chemistry. He has a Bachelor's degree in Biology from Lehigh University and has a Master's in Education from the University of Pennsylvania and a second Master's in Zoology from Virginia Tech. He has, since 1990, been a member of the adjunct faculty at the Abington Southwest Center of the University of Virginia.

I have asked him to offer some comments on the barriers to improvement in science education as he sees them today, some of the recommendations that he would have for changes that can be made in public education to meet the challenges that we talked about earlier. And then, for the balance of the day, to lead the discussion in which I hope all of you will participate and which will be extremely informative to those of us who have some responsibility for setting federal policy in this area.

Frank, we welcome you, and at this point, I will be pleased to turn the balance of the program over to you.

[Applause.]

STATEMENT OF FRANK WILLIAM TAYLOR, CHEMISTRY, BIOLOGY TEACHER, RADFORD HIGH SCHOOL, RADFORD, VIRGINIA

Mr. TAYLOR. First of all, I would like to thank the people that made this meeting here possible. I think we have a tremendous opportunity here to have people who are decision- makers, policymak-

ers to be here to listen to us and find out what our concerns are and what it is like to teach here in southwest Virginia.

It is terrific to have Dr. Williams here from the National Science Foundation. I think it is a tremendous opportunity here for us in southwest Virginia. The fact that Mr. Boucher, who is in an area where policies are made to be here to hear us. Dr. Exline, and also thank the New River Community College for having us here today.

What I am going to share with you, of course, is my views. And as a science teacher, I have to recognize that my views are replete with biases. And what I am going to be talking about today is not based on surveys, and it is not based on experimentation and data analysis; it is based on my experiences and it is going to be replete with my biases. So please keep that in mind.

I look at my role here today not to speak for you, but perhaps as a representative, and mostly to get you to think about the things that you would like to share here and things that you think these people that are here need to hear about, what it is really like where we are.

I am a high school teacher, and because of that, most of my comments are going to address more the high school end of the realm here. And if I do not speak as much toward the elementary people; it is not because I do not think it is important. Their role is critical in this whole thing. It is the elementary people that really set the stage for math and science. And the responsibility on the elementary people is tremendous.

This is a very complicated issue. You know, what are the barriers to effective science teaching? What are the hurdles that we have to cross? And it can be a very frustrating experience for us, as science teachers, to try to improve what we do in the classroom.

Right now, we are facing probably one of the most diverse student populations that the United States has ever seen. We have a wide variety of students with wide varieties of abilities and backgrounds. The fact is, American home life has changed in the last 20 years. We really are dealing with a very diverse audience. We have many, many expectations thrust on us, and it can be very frustrating trying to deal with all of those expectations. Many of the things you have heard here today, we need to make U.S. students number one in the world in math and science. We are charged with being more effective in the classroom. We are—many of us hear that we need to increase the amount of hands-on experiences that we do in the classroom. We are expected to produce a more scientifically literate society. We are expected to produce students who are ready to deal with the technology that again we know is out there, but we do not see very much of it in our schools. We are asked to raise the standards, and at the same time, we are asked to reduce the dropout rate. We are to meet the needs of the gifted, and at the same time, meet the needs of the at-risk students. And hopefully, somewhere in there, too, we are meeting the needs of the middle students or the average students. We are expected to spend more time in the lab in doing thinking and problem-solving activities and doing activities which are going to turn kids on to science and make them want to go into science. And yet, we are also expected to cover the curriculum. And Dr. Exline has given us insight there that perhaps we are going to be resolving that issue.

Co-contaminantly, we are expected to spend more time doing these lab activities, yet right now, I think many of us feel pressure that our students have to score high on these standardized tests that we have, and I am going to address some of those issues here.

Is there conflict between some of these expectations? Do all of these expectations seem to go together to us? And I raise those questions, and I think that you need to address those things here today in your comments. If we increase lab time, are students going to perform better on these tests that we all give in the spring of the year? If we increase all these hands-on experience, do these tests really measure what we are doing in the laboratory? Do they measure the skills the kids are learning? Are they—do these tests really measure the skills of dealing with technology that we are supposed to teach them? Are these tests appropriate to what we teach? And again, I think Dr. Exline and the VQEST program is going to help address these things.

Immediate concerns—many of us are going to have very different opinions on this—and that is a question of class size and number of preparations. Again, what I am going to share with you is not necessarily reflective of where I teach. I think I have an excellent teaching situation, and I am very fortunate to be where I am at a school where the administration is very, very supportive of what we do in the science classroom.

What limits should there be on class size? How does that fit in with these goals that are being mentioned here? I have talked to teachers where they have upwards of 30 and more students in the science classroom, and I am sure there are teachers here that are going to be able to share some personal experiences with that. How effective can we be with that many students in the classroom? What happens when we try to increase the amount of laboratory time? Do we have the money to fund those materials? What happens to discipline when you are working with groups that large—when you are working with five classes a day with 30 or more students in it? It creates—labs are more or less unstructured or less structured activities. How do the students respond to that? What is that impact of having that many kids in the classroom?

We see some liability questions there even. Are you taking a risk? Are you personally liable for what happens in that classroom as you try to do a better job to prepare those kids for these goals that we have mentioned? With all of these kids in the room, is your room adequately set up to deal with that, is it appropriate? These are some things I think we need to address here and look at the reality of our situations.

Numbers of preparations. I think that is particularly a—can be a barrier or a problem here in southwest Virginia as many of us teach in small schools where you are not teaching a full slate of one subject or a couple of levels in one subject. Many science teachers in southwest Virginia have multiple preparations—four and five preparations in completely different science programs are not uncommon here. And I think that is a particular question to address here. Where do you get the time to make this innovation? Where do you have the time to apply all of these things when you are so spread out to these things? So, address those things.

We look at our curriculum itself, and as Dr. Exline pointed out, we have some concerns there. Biology is often a terminal science class for many of our students. And whether that course should be the terminal class for these students or not is a question in itself. But for many of our students, biology is the last course they take. How well does biology really prepare them for all of these things we have talked about? How well does biology really prepare them in terms of scientific literacy, in terms of technology? I have to ask, are these students—once they take our biology class and that becomes their last science class—are they ready to handle and deal with constructively the local issues and national issues that are before them? These kids grow up to become the voters. Are they ready to make decisions on where to put the landfill? Locally, we have problems with that—trying to decide where is the best location for the landfill? Should we have a landfill? Should we look into developing a waste-burning electric generation plant in New River Valley? What are the impacts of that? What is the impacts on the air? How does that—does that solve the landfill problem? Are we really preparing—does our biology curriculum, as it exists now, really prepare our students to do that?

We take pride in serving all students, regardless of their abilities. And often, we have a very, very wide range of students in these classrooms. Is all of that stuff in that biology curriculum appropriate for all of them? Do they need those things that are in that curriculum? I think this is something that we need to address and we can share here in this forum.

Existing—I read a note somewhere that in the existing biology text—the standard biology text—there are as many new words introduced in the standard biology text for tenth grade biology students as there is in the first two years of a foreign language. And we are supposed to be doing this in English, right? I had some questions there about the validity of our current curriculum.

Technology in the classroom. This is, I think, a area of great frustration. And as you hear the speakers here today talk about technology in the classroom, it is a very frustrating thing for us because we see that technology out there. If you have visited any offices and industry, you visited laboratories at local colleges, there is a tremendous amount of technology—some of the things we have probably never even seen before. Technology is in a rapid state of change. Recently, we celebrated the—IBM celebrated the tenth anniversary of the invention of the PC. Look how far that has come in ten years. Yet, we go back to our classrooms and we look around—as was pointed out—and we see the chalkboard and desk is the basic setup of our classroom.

The kids probably have more exposure to technology than we do. They have got Nintendos and Game-Boys and many of them have computers at home. We see these new VCRs. The technology is all around them. Where are the applications of this technology in our classrooms? Do we have computers in the room?

We hear a lot about this technology, but we also have to ask, exactly what is technology? Exactly what are we talking about when we talk about technology? What is the technology that we are really supposed to be training these students to use? Who is going to define that? Where did that come from? I think that is going to

be very important for us as we try to do a better job in the classroom to know exactly what we are talking about, and what is this technology that we are supposed to use? What is scientific literacy? And I think Dr. Williams has addressed that also, and that is one of the goals of NSF to address that particular issue. We come to professional development, and professional development can be a source of some frustration too for science teachers. In many parts of the state, science teachers have not had raises in several years. And I think this year, there is some localities where that is looking to be improved. But many times, science teachers were being asked to go out, to seek out this professional development, get this training, yet we are doing that at a time where we may not have had a raise in the last two or three years. So not only are we not getting any sort of increment increase in our income, but we are also asked to spend more of our time outside of the classroom to do this. And for some teachers, that can be a real disadvantage there.

Participation in science conferences such as this. Should we have had more people here? Should more school systems have been represented? Should more science teachers have been able to come here today? I think so. And as was pointed out, we have to see changes in how administration regards what is important and what is important for science teachers. Personally, I think the attendance of science teachers at conferences, such as this one, at the state conferences, is vital to what we do. This professional development, I think, has to come in within our contract, and it should not be something that we have to do extra to figure out, to find out what is available, to go out and find out what we have to do. I think it needs to be part of our professional job responsibilities, and I think the administration has to not just encourage us to do that, but set it up so that we may do that within our professional responsibilities.

Science conferences are tremendous things. They are enthusiasm builders. If a school system can get all of their science teachers to go together as a group, it goes a great way to jelling that group of people to pull them together into a working unit to make these things happen.

Teachers, I think—one of the most important things, I think, can be done for teachers and to improve science teaching is to recognize the science teachers as professionals. And I think it is a two-way street, too. I think that if we are recognized as professionals, I think people will be startled with how much we can produce and how much we will do just based on knowing that we are doing the best job we can and that we are being recognized for what we can do.

I think on the flip side of that, we also need to recognize ourselves as professionals and we need to prepare ourselves to be professionals and to respond on that. One of the things—you know, a place you can begin—I wonder how many people here have a resume up to date or have a resume that they have prepared in the last year that is pretty close to being up to date. It is very important that we document all of our activities. It is very important that we document what we do and have that available so that when we go out and request more money for computers, request more money for technology, we can exhibit ourselves as profession-

als. There is many, many opportunities out there for science teachers. And if you are willing to go out there and look, they are there. And if you have documented what you have done, many of these things that you apply for, you have to go through some effort to do it. And sometimes, you have to write essays and fill out applications. But all of that will become more easier and much smoother if you are professionally prepared. If you—setting up a resume and a vitae does not mean that you are interested in seeking another job outside of your school system. It means that you are interested in exhibiting yourself as a professional and being ready to take opportunities as they come, and I think that is a very, very important thing. I think it is important that we are recognized as professionals and given responsibilities by the administration to make those changes that come up.

Another thing we have to keep in mind—and this is more on what we can do right now—is, you know, what are we really doing in the classroom? And we have many frustrations. We have many, many expectations. We have got—we seem to be pulled in a lot of different directions. And many of the things that we are expected to do are not well defined. And hopefully, with the VQEST program, those things will become better defined for us.

But something to keep in mind right now and something I try to keep in mind at all times. I have got this article here, and you can see how yellowed and brown and tattered it is, and I keep it taped up next to my desk as a constant reminder about what I am doing. The title of the article is "In Teaching Science, Curiosity Suffocates." And it is written by K. C. Cole of the New York Times just a couple of years ago. But every time I see that title, it brings chills to my spine thinking about what is happening in science. Is this really happening? Are we, in science classrooms, suffocating curiosity? If that is true, it is no wonder that science and math education is where it is now today. What are we doing in the classroom to do that? I think part of it ties in with curriculum. I think part of it ties in with our attitude.

A few excerpts here. Of course, as you heard, "In recent science tests taken by high school seniors in 14 countries, American students ranked 14th." Another quote, "Most high school students simply do not believe that they can learn science," according to a recent paper from the Science Teachers Association. "Science," Tressle says, "is inherently elitist. Studies have shown that low-income students—women, minorities, disabled—at best, are slighted in the classroom." And I think overall, as they have pointed out—the Science Teachers Association has pointed out, most students do not think they can learn science.

What is happening in the quote here from grade school to grad school is a suffocation of curiosity under an avalanche of raw facts. According to a study by Sigma Xi, the Scientific Research Society, entry level courses failed to stimulate students, much less educate them. So we have got some real things here to look at. We need to look at, you know, what are we doing here in our classrooms? Well, we can sit here and we can talk about—and as we will and as appropriate in this forum—some of the problems we have; some of the barriers we face. But the fact is, when we leave here and go back to our classrooms on Monday, we are still going to have that

same number of students in our classroom. We are still going to have that same amount of material and the same amount of our budget in the very near future.

What can we do now to change that? The kids are in our classrooms, they need us. We can make a difference. We can look to finding hooks for them to turn them on to make what we do more relevant. The flip side of that coin is some teachers will say, "Well, why are we responsible for that? Why do I have to motivate students? I should not have to motivate those students. They should come to my classroom. They should want to learn. Why is that responsibility thrust on me?" Well, I am not sure that it really is our responsibility and that we have to do that. But the reality is, that is the situation. The students are there in our classrooms. We can make something happen if we try to find some ways to hook them, to turn them on, to make what they are learning more relevant. And again, we were hearing a lot of really good ideas for things to change and to address those issues.

Finally, talk more about solutions and stuff and some hope. To me, I find a lot of hope and a lot of solution here in Science for all Americans, Project 2061. If you have not seen this publication, you should get this publication. To me, it has some very persuasive arguments or ideas about where science education should go. And this thing—I do not see it as a curriculum change as they call it. We have seen curriculum changes come and go since the 1960s. We have seen curriculums come in and curriculums go out. And basically, here we are; we are still back in the same place.

Project 2061, to me, is about fundamentally changing the way we approach science. Fundamentally changing our attitude to teaching science and exactly what is taught. They offer some ideas here based on several independent panels set up by the American Association for the Advancement of Science. But what are those tying themes? What are those concepts that kids really should be going out with?

One of the real thrusts of this—and I think the controversial issue and maybe it is hard for us maybe to accept because of the years and years of training that we have had under this philosophy. The controversial issue here, I think, is that—one of the basic premises here is that less is more and that we should seek not to try to teach that whole biology book and all of the pieces in that curriculum, but focus on certain concepts and do a better job of that. And to me, that takes some of the frustration out of all of those things that we talked about—about meeting the needs of all the students, about covering the curriculum, about providing hands-on experience, about doing minds-on experience, about preparing them for scientific literacy, about making them better writers, about incorporating math in our classroom—integrating all these things.

It is unmanageable and it is scary for us to think of it in terms of our existing curriculum. There is no way I can see that we are going to continue to cover as many words and facts and probably even concepts as we are doing now. What we have got to do is pare it down to find out, what are the real important things? What are the things that are going to make our classroom a useful place for these students—these students who may not go on in science—to

create an atmosphere that the students would want to go on in science. And I think a lot of the answers are here. There are some very persuasive arguments about what we should teach and what is meaningful and what is relevant and what is really going to be useful to them as preparing citizens who have to make decisions on things like the greenhouse effect and ozone. People who will go out and vote for the policymakers of our country who have great influence on those worldwide environmental problems and also on our own local issues here, like landfills and burning garbage for electricity. They need to be prepared to make those decisions.

Who is going to make these changes? How is it going to be done? Obviously, there is a very strong correlation here with money, and money is very important. I think there needs to be funding provided for that teacher training. That time must be made available within the system for that. We need equipment to be—to do the technology aspect of our job, to integrate that in. Now, along with that money for that equipment, we have got to have maintenance money. And that is something that sometimes becomes overlooked as you get these one-spot grants to do something. Where is the money to maintain that equipment and to keep it running? We have some concerns about class size. We have some concerns about preparation time and meeting multiple needs and multiple courses. So part of it comes from there.

But I think the central part—the main part can be addressed in us being professionals. And for this change to happen, for science teaching to really change and improve and make us number one in the world by the year 2000, that change has to come from within. And the administrators who we work for have to recognize that these changes are not something that are going to be done to us; it is a change that we have to make. And time and time again, I think it has been proven that whenever one group of people tries to place requirements on another group of people and those people do not have a say on what is going on, you are not going to have long-lasting change. We have to be the ones to make this happen. There are things that we can do in the classrooms right now to improve the situation. We have to seek out the professional conferences. We have to go to our administration and to our school boards and spell out what needs to be done. In order to do that, we have to present ourselves as professionals.

Parents need a role in this, too. I think that ties back and Dr. Exline addressed that. There has to be input from the parents and we need to have—kids need to do some extra work there, too. They need to make an effort. Education is not something that—with all of the great improvements we do—it is not something we do to the students; it is something that they have to respond with and they have to do themselves.

So, I would like to conclude my remarks then. And I guess at this time, we will open up the floor for your comments. Keeping in mind again, here we have a tremendous opportunity. I think it is a tremendous thing that this panel has been organized, that they are here to hear what we are doing in the classroom, what our needs are, what are the things that we can improve? This is obviously a rare opportunity for us. When have we had an opportunity like this to directly share in public forum to policymakers what is hap-

pening in the school systems and what we need, based on what we have.

I would also like, again, to particularly address the elementary school teachers and their concerns and make sure that those are aired out here, also.

If anybody would like to speak, the forum is here, and if you will raise your hand.

Mr. Mason, if you want to come up here and address the audience, make a few comments.

[The prepared statement of Mr. Taylor follows:]

Frank Taylor
Radford High School
50 Dalton Drive
Radford, Virginia 24141
March 31, 1992

Congressman Rick Boucher
Chairman Sub-committee on Science
U. S. House of Representatives
405 Cannon House Building
Washington, D C 20515

Dear Mr. Boucher,

After having met with you in Washington I spoke with Brad Penny on the telephone and he informed me about some of the details concerning the conference for science teachers in Southwest Virginia. He also asked me if I would write to you and share some thoughts on science teaching in Southwest Virginia and particularly address the issue of teacher morale. The following are some thoughts that I have jotted down. Naturally, these comments are solely my personal opinion, based on my experiences and are replete with my own biases. Some of the issues addressed are concerns to all teachers and some are more specifically related to science.

Science teachers have many expectations thrust upon them including:

-increase hands-on experiences
-produce a technologically/scientifically literate society
-raise standards
-reduce the drop-out rate
-spend more time in lab
-score higher on standardized achievement tests

Some of the expectations above conflict with each other, for example: do standardized tests measure skills developed in lab activities? We see technology rapidly changing on the outside but our classrooms remain relatively unchanged. To bring technology into the classroom costs money. (I know our budget for consumable science supplies has not increased in at least 10 years!) It is frustrating to see the technological changes occurring, knowing we need to teach it, but not having access to it. Along with these increased expectations, many teachers have not had any kind of raise in recent years. Class sizes have increased in many

localities. What is the influence of class size on laboratory activities? Class management problems increase with large classes in the less structured environment of the laboratory discouraging teachers from attempting labs. Our current legal system places teachers who go to the effort to provide lab experiences for large classses at risk personally liable for accidents in over crowded rooms.

It is unfortunate that some science teachers become offended by being requested by the administration to attend science teacher inservice activities. Instead of looking at this as an opportunity it is regarded as another duty being thrust upon. To request teachers to spend their own personal time outside of school hours (and often paying for the experience themselves coupled with no recent raises) strikes a sour note in their minds. Other teachers who are eager to go are often denied time away from school financial backing and may even be required to pay for their own substitute.

Teaching laboratory/hands-on science requires a lot of extra preparation time. To compound this many small rural schools require teachers to teach many different subjects further increasing preparation time.

What do I think we need?

Teachers (science teachers?) need to be treated as professionals. I believe teachers will respond as professionals. Science/technology is in a state of rapid change. Teachers need to be up to date on these changes. To this end they must have the opportunities to interact with other professionals. Teachers must be more than morally supported in this effort they must be financially supported. Teachers should not be encouraged but required to attend professional development activities. Attending such activities should be a part of the teacher's professional contract not an extra that they must find their own time to do.

Science teachers need to develop their own needs assessments based on national trends. Science teaching today is on the verge of great change. Not a change in curriculum (a new fad "we seen it before") but a fundamental reexamination of how we approach science (Project 2061). Funding must be provided to bring science classrooms to the level we are asked to go to. Class sizes need to be capped to allow for hands-on science instruction. (Could the need for extra preparation time also be addressed?)

Please excuse this rough copy/grammatical errors. (Time is at a premium of course.) I wanted to share these thoughts with you. This is really just scratching the surface of a complex problem. I will be glad to

discuss this issue further with you I hope that this letter is not too pessimistic I personally find many positives in science teaching and with my school and administration I am excited about the up coming conference you are planning for science teachers and I am thrilled that some one in your position is really interested in what is going on in the classroom Thank you for your time and efforts I believe that such efforts can have a great impact on what we do and yes even our morale

Sincerely

Frank Taylor

Frank Taylor

STATEMENT OF JACK MASON, TEACHER, MARION SENIOR HIGH SCHOOL

Mr. MASON. Thank you very much for this opportunity. I am Jack Mason from Marion Senior High School. This is kind of scary. I did not realize I was going to get up here and look you all right in the eye like this.

I want you to know that I have my Science for all Americans right with me and I do have some things I want to say. I hope I do not take too much time. What I am worrying about is a bathroom break and lunch and things like that.

But I have been a college teacher for about 20 years, and just this past year, I took my leave and went back to a high school environment teaching Earth Science, ninth graders. In our school, the best ninth graders often take biology instead of Earth Science, so you know I am not working with the best students and the easiest job in the school. And I have some things to say about that.

There are several things that I have learned—and maybe you already knew them—but I learned them this year. And some of these things, I want to say and I would like to follow them up if I can get that much time to do it. But if I run into somebody else's time, please let me know.

There is a tremendous amount of curriculum and instructional materials available to teachers. So much that we can only really take a look at a fraction of it. We would like to have some way to get a better chance to look at that material and sort it out to use in our classrooms. Now, I am saying that in the most positive light. Now, I want to come back to that a little bit later.

Secondly, kids are still kids. They still have a lot of curiosity and they can learn. That is not, I do not think, a problem in our schools. Now, there are some problems in association with that, but the kids still can learn.

Schools have changed, in my opinion, more than children. I think also that most adults have changed more than children.

Some problems. There is insufficient time to sort out the materials which are right for our students. Adults in schools have changed so much that they cannot control children well enough to create a good learning environment or a learning situation. Children are now running the show, I am afraid, in too many cases and are rude to many of us while they run the show. Many of the children in school now were hoodlums in past years—I am thinking 20 or 30 years ago. And these people, with their foul language, their obscene habits—make schools a rather poor place for the good kids to learn. And I am not—I do not want to sound terribly negative on that, but there is a strong element of truth to what I just said.

[Applause.]

Mr. TAYLOR. Thank you. That relaxes me a little bit.

VOICE. I have a question for a second. Do you mean these kids would not have been in school 20 years ago?

Mr. TAYLOR. I am saying that some of these kids—certainly some of them would not have been inside our buildings 20 years ago. I am not saying they should not be there, but we have to be able to deal with them, and we need help to deal with them. Okay Southwest Virginia teachers teach in small—I am thinking a lot of

them—maybe not everybody—teach in small, cramped, poorly equipped spaces not suited to modern science. Most science teachers do not have even a small office space in which to work. Now, I heard—I heard Mr. Taylor say his desk. Some of us say, "What desk? Is he talking about the one he has at home?" That desk is usually in front of a classroom, and several people will use it during the day and it is used mainly just for classroom procedure, not a place where you can lay out your work and work on it. I go running around the building with this great big monstrous briefcase that I found at K-Mart. In fact, it is my second one. I wore one out already. And I run around the building finding a place where I can sit down and do some work. I would like to see some of the professional business people and executives around the country keep up with me, let alone get their work done at the level to compete with the Japanese. Okay.

I do not have access to that classroom any time during the day, except like 7:30 in the morning or 3:30, 4:00 in the afternoon, and I usually cannot go back there then because I am taking care of all of those phone calls to parents and things like that that I have to do so I am going to be able to survive the next day. Modern labs cannot be prepared, folks, out in the hallways, and creative labs cannot be designed if you are working after eight hours of grueling work in the classroom. You cannot be creative under those circumstances.

[Applause.]

Mr. TAYLOR. Thank you.

Okay, what do I recommend? And this is all a thumbnail kind of thing. I wish I could talk about this for two or three hours, and I would like to get in dialogue and argue it. I would like to back up what I say with a lot of ideas I have. I do not know, maybe Mr. Boucher will stay around and we will argue for two or three hours and I can get it out of my system.

New laws to help bring children and many parents under control. These—that is a recommendation. I want you people to get it for us.

[Applause.]

Mr. TAYLOR. And I am talking about bringing the parents in line because it is—the children will get in line if the parents get in line and we get in line and make them do what they should. If these people are going to have babies, then they must be responsible for these children's education, as well as a lot of other needs that those children have. Parents must be held responsible for the child's bad behavior—and that includes detention for the parents in jail if necessary—but that is what we got to do. Otherwise, these children in southwest Virginia will be doing what they were doing in Los Angeles a couple of weeks ago. They are trying to do it right now in some cases.

Teachers must have power to remove chronic problem children from their classes. That has got to be up to teachers.

[Applause.]

Mr. TAYLOR. We are the professionals. If you really want to elevate us to professional status, that is a change that needs to be made soon.

Schools must have, I think—to deal with those children that cannot stay in the regular classroom, we must have bigger and better alternative programs because I am not in agreement with just kicking them out on the street. We have to do better than that, but some of them just do not fit in the regular classroom.

Okay now, this is one that might go against what some people think. I do not really expect that we can rely on more community involvement to solve all of our problems. That is kind of a panacea right now, and I believe in it; I really do. I wrote a letter to Lamar Alexander, and I shared that letter with Rick Boucher and others. And I did not write it particularly well. I am too wordy, as you can tell right now. But what I was trying to say in there is that we have all of these problems in school, and the answer I got back was that—from Lamar Alexander's research assistant, she said, "Everything you have said is correct. It is backed up by research." And then, she said, "Here is the solution. We are going to have more community involvement." Now okay, great. That is going to help some, but are teachers going to get highly involved with the community? Where are they going to add that on to what they are already doing? Their energy is already sapped. You have got to take half of their day away and give it to community involvement kinds of activities, yeah, then they might be successful if you reduce their loads by half, something like that.

I am not saying, "Do not do this." Yes, do it, but do not expect it to solve all of our problems. It will not do it by itself. I spent something like 80 or 90 parent conferences this year. I know how much energy that took away from me and that went away from my instruction. My instruction would have been better—much better—had I been able to spend less time with parents and phone calls and so forth. And some of them took three and four times; some of them, I had to go out to the homes. In some cases, I was successful; in others, I was not.

We are going to have to spend more dollars on work space and preparation time for teachers. We are going to have to find the way to give them more time to prepare these creative labs and we have got to have time—I mean we have got to have a better place to work—it must be better. We have to have a place to lay out lab materials and put them in the right shape so that we can get them into the classrooms. So, more time either in that lab or in a preparation area.

And I guess lastly and maybe most important, Congressmen, legislators, Governors, Presidents, you all need to work on ways to raise the status of teachers. People have to start thinking about teachers as really important people and people at the level of doctors and lawyers if you want us to really be successful. And I think laws and action can be taken at the higher levels of our government and the local levels to help us get that status. And I think when that happens—when these kind of things happen, you are going to generate so much activity among teachers at least in southwest Virginia that we will just sail right on past the Japanese.

I thank you for giving me this much time.

[Applause.]

[The prepared statement of Mr. Mason follows:]

Route 2 Box 261
Meadowview VA 24361
March 17, 1992

The Honorable Rick Boucher
Member of Congress
188 East Main Street
Abingdon VA 24201

Dear Rick:

Back in December you wrote requesting my counsel about matters of regional and national interest. A major interest relates back to our discussion about science education when you spoke at the fall conference of the Southwest Section-Virginia Association of Science Teachers (SW-VAST). At that time you suggested that representatives of our organization have a discussion session with you. We are ready.

Enclosed is a copy of a letter I sent to Lamar Alexander. Although that communication was a personal effort on my part, it reveals much of what the other teachers want to discuss. Would you read the letter then talk with a small group of our leadership? We think reform of education is going too slow and the present leaders may be forgetting many of the real needs of teachers.

Thank you for your letters and for giving me an opportunity to share my ideas.

Sincerely,

Jack Lee Mason
Home phone 703/944-5046
Work phone 703/783-4731

enclosure

March 17, 1992

The Honorable Lamar Alexander
Secretary of Education
Executive Federal Office Building #6
400 Maryland Avenue, SW
Washington DC 20202

Dear Mr. Alexander:

I am writing to you out of grave concern for the education of secondary school children. My situation is unique and I believe I can provide information about education that may be revealing and of help in the critical reshaping of schools for the future.

After many years as a college teacher and administrator I chose to use my leave time to teach for a year at the high school level. My position at the college is to train student teachers. Because it has been nearly twenty years since I last taught in public schools I thought this would be a valuable way to spend a year. Besides learning a lot of do's and don'ts for my student teachers I have learned a great deal about what schools should be doing differently. This letter is a glimpse of some of the most prevalent problems which must be addressed if schools are to improve.

I invite you to visit my school and learn first hand about the handicaps under which teachers are expected to work. You need to see the problems from the teachers' perspective. Correcting the problems in education from the administrative viewpoint has been tried many times with no real success. Following psychological research and educational studies has often added to our problems. I believe that observation of the real problems with which teachers must contend, will reveal common sense solutions that can allow teachers to create all kinds of improved learning programs. Some of the laws and policies affecting teachers must change. TEACHERS MUST HAVE MORE POWER TO DO THEIR JOBS.

To share my story I need to describe some of the situations encountered in the first half of my year. I ask that whatever you do with this information please protect our schools and the personnel from bad publicity. The people I am working with have been wonderful to me. Most of them are caught in the same bind as educators everywhere. We are not unique. I am past president and presently serve as advisor to the Virginia Association of Science Teachers (VAST) and I hear these same problems from teachers throughout the commonwealth. It is also important to understand that any criticisms on my part are not sour grapes. I

page 2, Lamar Alexander

am having a successful year. One of my supervisors has nominated me for an outstanding teacher award.

I received my assignment to teach at Marion Senior High School in Smyth County Virginia in July 1991. Approximately ten days of July and August were spent redesigning the lab facilities of my room. Some repair was essential to make these facilities safe and this work was done by the school board. My own time was spent cleaning and repairing carts, tables, and storage space. I also had to create a workspace for myself in the corner of the chemistry storage/preparation area which is still not adequate and I am not sure that it is really safe.

The first semester has been a time of terrific adjustment. The amount of time I had to spend on non-teaching activity was unbelievable. Much of this time (approximately 200 hours) was devoted to calling and conferencing (including visiting homes) with parents of unruly children. The amount of immature, disrespectful, and rude actions youngsters are permitted (by parents and school people) to visit on teachers and principals is a disgrace.

Certainly there are connections between respect of teachers and education and the quality of learning that takes place. Well over fifty percent of the students I have encountered do not have this respect. Class content and attentive students have suffered and are still suffering while I teach manners and work endless hours to gain and maintain control. The school administration worked hard with me but in essence admitted they lacked the power to correct a very bad situation. Breaking up hall fights and moving students out of their cooperative learning groups because they are spitting at each other should not be common teacher duties. Virtually everyday I still have to deal with a student who is rude. With the help of principals and parents we have reduced this problem from a situation which occurred several times every period. I will not put in print some of the remarks students have made. I submit that similar situations are all too prevalent in American schools.

Many students will not be respectful so long as most people hold teaching and teachers in low esteem. Neither can teachers overcome the problems of student bad manners and hostile behavior when they have little power to correct behavior beyond appealing to parents who often cannot or will not control the youngster themselves. Teachers find it difficult to build respect when the system forces them to pass students who are absent thirty to fifty percent of the time and often create problems when they are in attendance. It is difficult for teachers to gain respect when they work under conditions no other professional in our society would tolerate. These conditions include no private desk, very limited access to a phone or computer, lack of workspace, cramped classrooms with broken furniture. Most school systems cannot provide secretarial help to type and duplicate material. Few

letters are sent to parents because after a twelve hour day there just is not enough time. If time were available lack of funds for postage would still prevent action. Even our good students from good home environments have difficulty maintaining a positive attitude toward education. Is it any wonder, when every day they observe the conditions described above. What can we do to improve this attitude?

Obviously, many of the changes needed are beyond the teacher's influence. Teachers in Japan do not worry about their students having respect for them or the education system. Their culture will not permit the nonsense that our teachers have to tolerate. Only the leaders of our country and our communities can significantly improve the attitude of our society toward education. Initial actions must include the uplifting of education by giving more than lip service in support of the effort teachers make. Most teachers need a better work environment with more tools and time to prepare lessons that fit the needs of a changing student population. Teachers must have more power to make more of the decisions involving curriculum and instruction, and they must have the authority to determine who is going to remain in their classes. We have two common occurrences which greatly undermine teacher effectiveness. Being forced to keep a chronic problem, sometimes hostile student, in class is a dilemma that needed correction long ago. Teachers must also be permitted to remove students from elective courses when they demonstrate lack of background preparation and an unwillingness to do the extra work to overcome the weakness. (An example is low achieving students in foreign languages or advanced mathematics who are there only because they or their parents feel it is their right to take any course they desire.) To grant teachers any less is to say they are not capable of making professional decisions. Teachers are not going to abuse this power anymore than other professionals violate their responsibilities. We are not about to dismiss ALL students who become unruly. However, there are some students who do not fit the regular school program. Teachers need to decide who these youngsters are and remove them before damage is done to the education of the remaining students. Schools have a responsibility to provide alternative programs for these students. However, many communities do not sufficiently fund schools to provide this. It is time for community leaders and school officials to work together to correct the problem.

Teachers must be free of pressure to make school easy for students. Many educators expect teachers to give unlimited time for make-up work, prefer that teachers get everything done in the classroom because "children don't have time for homework," and nobody should fail. I chose to give homework because I know it is important to good learning. However, I still must tolerate very low standards of performance, because if I fail all those who refuse to do their work I will be in trouble. Often I must set the failure level well below fifty percent to get a reasonable number of passing students. Most of these students have

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sufficient ability but their attitude is that school is for socializing and learning is incidental.

Students can miss almost any amount of school and still pass. They can be rude, obscene, and vandalize the place with only light penalties when and if they get caught. Self discipline will never be learned because our loose system teaches them that responsibility is not necessary. We have created a monster and no amount of school reform will bring about better education until teachers have the authority to make students be respectful and meet reasonable standards.

I would like to meet with you and suggest measures which will provide teachers the power to be more effective. Can we not find ways to uplift teachers from a position where they are often abused to a level where they are respected as important individuals within a real profession? This doesn't require a lot of money. Teachers are not looking for large salaries. They want a safe, clean, comfortable place to work, and the power to require children to do what they should. If these basic needs of teachers are overlooked again, the efforts to reform education will be money and effort wasted. Give teachers the clout to deal with the problems outlined and they will provide instructional programs second to none.

Sincerely,

Jack Lee Mason
Teacher of Earth Science
Route 2 Box 263
Meadowview VA 24361
703/944-5046

cc: Rick Boucher, Member of Congress of the United States
Joseph P. Johnson, Jr., Member of Virginia House of Delegates

Mr. BOUCHER. Well, thank you. That was totally unplanned and spontaneous, and that is exactly the kind of comments that we are looking for, and we hope to hear from each of your during the course of this afternoon.

We will break now for lunch. It is 12:30. Lunch will be until 1:15.

[Whereupon, at 12:30 p.m., the Subcommittee recessed, to reconvene at 1:15 p.m., the same day.]

AFTERNOON SESSION

Mr. TAYLOR. We would like to get started here where we left off. Jack Mason gave us a number of concerns to consider. And what we would like to have you do, we would like to give as many people an opportunity to speak as possible. We are going to extend this part of the session a little bit longer so we can hear from some more people.

On our schedule, it calls for the first panel to begin at 1:45. If we have the interest, we would like to continue this until 2:00 or 2:10, depending on your responses.

We have set up microphones down here in front of the stage to hopefully make it a little less intimidating to come up here. And we would like to really encourage you to come up and share your concerns and share your ideas.

So, we would like to go ahead with that. Do we have anybody interested in kicking this off?

Mary Norris, I think.

I think that was a little biasness on my part.

It may be good to—when you come up, please introduce yourself—as you will see right after teacher--please introduce yourself and maybe mention what school you are from and what subjects you teach and make your address.

STATEMENT OF MARY NORRIS

Ms. NORRIS. My name is Mary Norris and I teach at Radford. I teach physics and math. This year, it is physics and whatever because there are never enough Physics classes for a full-time physics teacher, as I am sure is the case in most southwest Virginia schools.

And I have two points I would like to bring up. The first is being a physics teacher, I encounter isolation in my school. There is no other physics teacher. It is me, and if I want to confer with a colleague, then I have to either get to a meeting or I have to get them on the phone and I think that we all know how hard it is to get another teacher on the phone because, you know, either you are in class or they are in class. There is nobody to take the call. Where is the phone? Well, it is down the hall, you know. So, what do you have to do to use it.

And I do not know how that can be addressed, but I feel that it is a big problem that when teachers get together with other teachers of the same subject, that it just produces a really good atmosphere for creativity and for sharing of ideas. And that is something that needs to happen more often.

The second thing, I think, is something that has been brought up already, but I have something to add to that, and that is our lack

of time. As science teachers—and I have taught math as well—I think we would all say that science is different from the other subjects, and all subjects are different from each other. But I think that science is different in that it demands a large amount of time to prepare to teach well. You know, we have to wade through all of the new material. We have to wade through the fact that science is an ever-changing subject and we want to be on top of the latest advancements in our field. And then, we also have to plan what we are doing among that new material and we have to set up labs, as well as teach lectures. We have to grade our labs, grade our tests, grade our regular papers.

We need somebody to stand up and say that teaching science is different, that it requires more time than other subjects. I can only speak from the experience of having taught math, but I know that science is much more demanding of my time than is my math. And somebody needs to address that and say that it is okay for science teachers to have more planning time than, say, other—teachers of other subjects.

Thank you.

[Applause.]

Mr. TAYLOR. Dr. Williams can address that.

Dr. WILLIAMS As a general comment, I was particularly interested in your observation about the paucity of phones because this morning, I talked about NSF's desire to establish a network—telecommunication network, and clearly, what you just said is—would be a right limiting step. So, that is a very useful observation.

VOICE. May I make a response to that? I went to a BEA fact meeting Wednesday night, and one of the issues that BEA is addressing is to have a phone in each room, not necessarily to confer with colleagues, but the idea is that in case of an emergency situation, the way things are going. They are going to try to push for a phone at least accessible to the teacher—close by to the teacher, which might help.

STATEMENT OF DR. JOE BERRY

Dr. BERRY. I am Dr. Joe Berry from Carroll County and I am impressed with this group that came out today, Congressman Boucher and Dr. Williams, Mr. Taylor.

You asked for some type of possible solution to this, and I have been in education many, many years. I look back at our programs in vocational education, Mr. Boucher. We do not have a scarcity of money for laboratories. We have a limited number of children because of safety, and the way you handle programs and vocational shops, the equipment is always updated. We have 12 months' employment for planning and getting materials ready for the coming year, also for staff development.

I would certainly challenge you and your Commission to look at that type of funding and that type of opportunities for our science people. I am also Director of Chapter I for Carroll County and have been for 26 years. For elementary children, you might very well use that model—the Chapter I model where Joe here is going to set standards, he and Dr. Williams set standards for science. And once you have those standards set for the academic achievement in sci-

ence, as well as material, equipment, staffing, staff development, parent involvement and all those components, if you set those standards and then take those standards and measure them against Carroll County or Scott County or wherever and then fund these projects so that you have reduced class sizes, have talented and creative teachers who can do a good job with teaching science.

And I think we can get away from Socrates' model, which we cannot use any more. One student and a good teacher on the opposite end of a log does not in 1990 or the 21st century make a good science program.

Thank you.

[Applause.]

Mr. TAYLOR. The lady in the white blazer.

STATEMENT OF CAROL MANSARD

Ms. MANSARD. I am Carol Mansard; I teach Advanced Placement Biology at William Clemmons High School in Roanoke City, and I have been head of the Science Department there since 1976. And I want to thank the group that invited us today, particularly for inviting individual teachers to this forum because oftentimes, things get led astray when they are sent to administration. We do not necessarily hear about them, so I applaud you in that effort. I had a phone call a couple of months ago getting the list of names of teachers to send those to, so I was aware of that.

I wanted to bring up one item that has particularly concerned me and has come to the forefront over the last couple of years that I have become aware of. We have many students. We work very, very hard to keep our students interested in science. We have an excellent school. They leave us as high school students ready, willing and able to be good science majors in college. And I have had several different people come back to me, sometimes after several years, and say that they got shot down in those freshman courses at the college or university level. And now, this is a continuing problem. And I would like to pose the question. I do not know what the answer is. I have discussed this at various forums in the past year. I do not know what the answer is.

But certainly, women and minorities particularly need to be encouraged. I do not know whether they need support groups. We have them for the handicapped and disabled on the college and university level. But something needs to be put into place so that they do not become discouraged and do not opt out that figure of 50 percent dropout in the freshman yearwas mentioned earlier. Something needs to be done at that level.

And we need better communication between the colleges and universities and the high schools, not only better to prepare our students for what they need to have when they go there, but also to keep them revved up, so to speak and continue—have them continue as science majors and see it on through.

Case in point, we have sent several of our valedictorians to what will remain an unnamed university in this state. They were both planning to be doctors. One came out an English major, and one came out an econ major. And that happened before the second year was over. And I just wonder, what in the world is going on?

Now, like—yes, sir.

VOICE. I would amplify what you have to say about that.

Ms. MANSARD. Okay, fine. One other point that I would like to make, just talking about frustration sometimes. We work very hard in our department at my school to see that every teacher is in their own classroom laboratory all day long. We expanded our Science Department to double its size five years ago. In the last two years, the powers that be have put all of my teachers on duty at other places—not necessarily anywhere near their classrooms—so that they cannot get back into those facilities that we do have.

And this business—I was saying "Amen" when you were talking about getting administrators involved here because this is—these are the people we have to approach because they are the ones that are making those kinds of decisions.

Thank you for your time.

[Applause.]

Dr. WILLIAMS. Two quick comments.

The gentleman who spoke about the equipment needs—about using vocational education as a reference point—has identified what clearly is a major gap in our current agenda, and in fact, is a gap that, Congressman, I think, is unacceptable. We are paying an unacceptably high price for it. It will take a considerable amount of money to deal with science equipment needs. But the amount of money has to be put in context of what we are already spending. Let me say it a different way. If one is really concerned with costs or rate of return on investment, I would suggest that our present agenda is not a very efficient one, despite how noteworthy our teacher development, teacher enhancement, course and curriculum efforts are if we do not have the requisite basic equipment in a variety of systems to allow students to learn science in the fashion it should be addressed. So, it is a need that has—in my judgment, should be addressed by a combination of action.

On the last point, you spoke of the difficulty with the transition. One of the very important reasons why we are giving so much attention to the lower division of the undergraduate sector is that I think the country can no longer afford this time-tested partition between K-12 and certainly the first two years of college. I often think of it as K-10-14. That is what is critical, to get students—once they get beyond middle school's math and science, the critical issue then is to make sure they learn substantively science in a continuum. And if they are college-going students, what colleges have to do is to regard their freshman year of courses in general chemistry, physics, et cetera, as a continuum from the 12th grade. They do not.

The other problem that is a major challenge—and this really goes to the culture of many colleges and universities—is that they have operated in terms of student population as inverted funnels. And I say that with all candor. The serious enrollment is the upper class—juniors and seniors. And Science and Math Departments have made an art form of this process. It is a 60-odd year old legacy that perhaps was all right to filter out large amounts of talent in 1945. But in 1992, given the enormously difficult and less than favorable position of this country in the international arena, it just simply is lousy educational policy. And it will continue to rebound

negatively on your efforts in the K-12 sector until it is addressed. And I think nothing short of candidly describing it precisely as it is is going to result in the kind of reform that needs to take place at the college and university sector.

VOICE.They should not use science and math to weed out their major.

Dr. WILLIAMS. Well, that is precisely what they are doing. And the reason is is that—let me just say it very simply as a scientist. Science departments, especially those in universities that have substantive research programs, desire a very small number of majors as undergraduates. Well, if unfortunately, 200 students present themselves to the university as freshmen and you really want 30, then you have two semesters—two years to reduce the numbers, and that is essentially what happens. Now, if you reverse that mindset and say that our responsibility is to start with 200 entering students and constructively and positively translate those into Bachelor's degree recipients in science and engineering, we have an entirely different result.

But that is not going to be accomplished by manipulations or small changes at the margin. What has to happen is a fundamentally different mindset with respect to the enterprise that colleges and universities are engaged in. Until that happens, we cannot address the problem.

So, the attrition of 50 percent is really no different than it was 30 years ago.

STATEMENT OF KEN ABLE

Mr. ABLE. I am the oddball here. I am not an educator. My name is Ken Able, and I am one of the recipients of a science and technology education.

For 30 years, I have been involved in science and technology—three years in research at Utah State, two years at Oxford, two years as a staff fellow at the National Institutes of Health, and the rest of the time in industry, with the exception of the last eight years, where I have been running my own company doing contract research for various Federal Government agencies.

What I would like to say is really a verification of what the last three people have just said, and that is, we have got some real problems—some real problems. And I would like to use myself as an example of this. When I went to high school, I took two classes in high school that were useful to me—two classes, which is one more than I took when I went to college.

[Laughter.]

Mr. ABLE. One of those classes was a one-quarter class in business law. I have never been interested in business law, and even though I have run my own company, I am still not interested in business law. But that class was taught by what I guess you would now call an adjunct. It was an individual who was an attorney, a state legislator and he made his living farming because he lived in a community where there was one attorney, and you know the old story about that. He taught us one important thing, and that was that it is not what you know that you counts, but what you know where to find.

The other class that I took was chemistry. And again, it was taught by a farmer who taught one three-quarter class in chemistry each year. The first quarter—we were a farming community and we, as kids, did not do homework. We never did homework because we simply did not have time to do homework. We also were responsible for helping to bring the crops in in the fall and plant them in the spring. So we could count on losing several weeks in the fall and usually, a couple of weeks in the spring from school. That particular year was a particularly bad year, I remember. In my first quarter of that year, I was in school three weeks—three weeks. It showed up on my grades, obviously. In chemistry, I got a "D" and in most of my other classes, I got "Cs" and "Ds."

By the end of the second quarter, my chemistry teacher came to me and said there is no reason for you to take the final quarter of chemistry. You do not have to come to class. He ended up giving me an "A" for the entire year, even though I really only attended one quarter of his class. It seems I had a talent for chemistry, but I did not recognize that talent and I had no intention of becoming a chemist because we had no role models. Our chemistry teacher was not chemist. He had been trained as a chemist; but he was not a chemist.

When I went to college, I intended to go into business school. But back then, going to business school was more expensive than attending a land grant college, so I attended the land grant college because I did not have enough money to go to business school. My first year's tuition and books at that land grant college were about $150 for that year. It is a little bit different today, is it not? It is a little bit different today.

Earlier this morning, the question came up as to why we do not have very many of our top students going into college. Well, that is one of the reasons. You cannot afford to go to college. Let us face it, you cannot afford to go to college.

Anyway, since I could not get into business school because I did not have the money, I, by accident, was assigned as my advisor the head of the Chemistry Department at that land grant college, so I became a chemist major. And I saw exactly the same thing that was described earlier. We had two classes in chemistry—one for the general students—you know the biologists and the humanities and so forth and one for science and engineering majors. And of course, that is the one I was in. And it started out with—well, the auditorium was certainly larger than this, so it must have been 150-200 students. By the end of the year, there were 20 left. That is exactly what you have indicated is still the case. I got an "A" out of that class. But you know how I got an "A"? Everything I needed to know to pass that course, I learned in one quarter of high school chemistry. Something is wrong with college when that is the case—there is something wrong with it.

Physics was the same way. My first quarter in physics, I got a "C" and I worked hard for it. And the second quarter, I worked harder. I am sorry, I got a "B" in my first quarter. The second quarter, I worked even harder and I got a "C". And the third quarter, I decided I was going to learn it on my own, and so, I never attended class, except to take the test. I never attended a lab that third quarter, and I got an "A". There is something wrong when a

student can learn better by himself than when he is taught by a so-called professional educator.

But of course, you have got a different situation at the college level than where most of you are. You have had professional level courses in how to teach. How many college professors have had even one class in how to teach? I will bet there is not a single one out there. I take that back.

I have a friend who is a biomedical engineer over at VPI whose degree—even though he is in the Engineering Department—is in Education. So, he has obviously had classes in Education and he is one of the best professors over there. So yeah, there are a few.

But this is a problem. We do not have a mechanism whereby we can provide role models for our students. You can be the best science teacher in the world, but you are still looked upon as being a teacher; not a physicist, not a mathematician.

And the other factor is that there is too much of this segregation. What I am? Am I a chemist? No, I am not a chemist. But I have worked in chemistry and I have published in chemistry and I have patents in chemistry. Am I a biologist? No. But I have worked and published in microbiology. In fact, I just finished a $550,000 contract in microbiology. Am I an engineer? No, I'm not an engineer, but I have designed an awful lot of things. Am I an architect? I am have designed and built buildings and hospitals.

Science and technology is not a matter of becoming a chemist or a physicist or a mathematician. Science and technology is a basic background in science and technology and math that allows a person to utilize the real world. And sometimes this is forgotten.

Let us talk about math for just a minute, and then, I will quit and let you teachers get on with your work. I majored in chemistry, but before I got a degree in chemistry, I changed my major to biology. And one of the reasons I did it is because I was going to be required to take some high-level math—this was beyond calculus—that I knew I had no use for or no need for and no aptitude for.

See, I worked my way through college doing research. I had six publications in international journals before I ever got my Bachelor's degree. I knew what the real world was before I even left college. In 30+ years in a very wide range of scientific and technological efforts—and successful efforts, I believe—not once have I ever had a need for calculus. Not once has any of my associates ever had a need for calculus. I do not know anybody who has ever used calculus.

[Laughter.]

Mr. ABLE. When I got a Master's degree at Duke, they used calculus to weed the class down from 116 people to a feasible 15. It was a business degree. Nobody in business uses calculus. Let us use some realism in setting up our curriculum. Let us see if we cannot get something going. And obviously, what is being discussed here is an effort to do it, but it is going to take—you know, you and I are not going to have much say in this. I am not sure whether you are going to have much say in this, to be quite honest with you. I hope you can—I certainly hope you can. But until we get over this viewpoint—this problem that in college, in particular, our college teachers were taught by teachers who were taught by teachers. And the

real world out there—the world that I have lived in, does not have any input.

Mr. Taylor, you said one of the big problems was figuring out what in all of this vast information you should teach. Ask some of us who have been out there.

I looked over the graduate school offerings at VPI in analytical chemistry not long ago. You know, their three-year or more program in analytical chemistry to get a Doctorate in Analytical Chemistry, we would cover and have covered in industry in three weeks' time. And the students—the quote "students" who were employees, obviously, within six months were performing as well or better than Ph.D.'s who completed those kinds of programs. Let us use some realism here. Let us start looking for real solutions.

And like the American Association for the Advancement of Science Program, the 2061 program, I am 100 percent back of that. We need to teach less in order to teach more. Like my business teacher in high school said, "It is not memorizing a lot of facts which are going to make us successful, but learning how to learn is going to make us successful." So please, let us do that.

Thank you.

[Applause.]

STATEMENT OF BUTCH KELLY

Mr. KELLY. My name is Butch Kelly, and I have taught 20 years of physical science, biology and earth science at the William Byrd High School in William Byrd Meadow up in a little town called Venton, Virginia. And I am here today because I am mad and I have been mad for about six years. I still love to teach school. But I am frankly tired of being bashed all the time. Every time you turn around, the schools are not doing this; teachers are not doing that. But the truth about the tests is—the other countries, the people who take the tests are cream of the crop and top line students. Here, everybody takes tests. Colleges are complaining because the students they are getting are not the quality they were 30 years ago. Thirty years ago, only male students who were the top kids took the tests; now, everybody takes the tests. So they are dealing with everybody. We cannot expect, you know, "A" students if they are not "A" students.

Another thing that I am upset about is money, material. We have a teacher at our school who is retiring. She taught 35 years—one of the finest ladies I know. But she said that since 1960, we have not had science labs upgraded. So in other words, she has taught her whole career and only had one time that her science labs were upgraded. Something is wrong.

You talk about having computers. Try having three computers in eight rooms. You know, you are sort of like the race car driver trying to push all of the computers around. Lab equipment is in sore need of repair. We need to replace it. We need to come to the 20th century. Chalk dust does not equal gold dust.

Another thing that has upset me is that we are not guiding students into technology training. We are trying to make college students out of all of them, and they are not prepared for that and some of them, really frankly, do not have the ability to do it.

The other thing that upsets me—and I will finish my spouting off here, but I am glad I got to chance to and I thank everybody that had anything to do with this conference for setting it up—there was once a teacher who sent a letter of resignation, and she said that the teachers are afraid of the administrators; the administrators are afraid of the school board; parents are afraid—school board is afraid of the parents; parents are afraid of the kids; and frankly, this has got to stop.

Thank you.

[Applause.]

Dr. WILLIAMS. I have one comment. Incidentally, I am in agreement with everything you said, in particular, on the issue of equipment and the lack of support. The issue of international assessment is true. Our student body is more heterogeneous. But I think the important bottom line—there are two important bottom lines. So, if you do it nation-by- nation, the comparison is—maybe one might say is intrinsically unfair. The problem is we cannot change that. We are stuck with our country, as the U.K. is stuck with its country, as Taiwan and Japan are stuck with their countries. The world market is buying in direct proportion to quality of the same scientific and technical human resources. Our challenge, the take-home message for us as a country from the international assessments is that for those 78 percent of our students who are now taking the tests, compared to 40 years ago—55 years ago, to be precise—are simply going to have to be this subject of a comprehensive address.

So I think the challenge as you put it to simply move, if you will, to positives in terms of what we should do. The relationship between the assessments and the paucity of equipment and all of the other things we have talked about simply says that effort has to be more sustained.

One other point, I guess that is worth observing is that—one of the comments that I tried to emphasize this morning is that I think this whole enterprise—math, science education—has to be reduced in part to a sort of problem-solving exercise. We are reluctant to bring to the reform process all of the factors that we think are important for advancement. We do them incrementally. We do a few. We spend an awful lot of money—local, state and federal, and then, we repeat it again.

I particularly like the fact that you sought to actually try and go through all of the things that are really needed if, in fact, we are going to make a difference. As long as your anger is constructively disposed, you should keep it.

Mr. TAYLOR. I would like to hear from elementary teachers. We have addressed mostly the secondary school end of it.

Mrs. May, are you prepared?

STATEMENT OF MS. MAY

Ms. MAY. I do not know that I am the only elementary teacher here, but I know there are not many of us. We looked through the whole list and we could find three.

And I guess I want to speak primarily because there are so few of us represented here, and I think this is sort of endemic of what

happens across the curriculum when we look at it from K-12. We see the upper end being proportionately much more than the elementary representation.

And I do want to say from my perspective, I am an elementary teacher. I teach everything. I do not have a choice; I teach it all. And I do know that I teach science very heavily. I teach science; I teach space education; I teach technology education. And I am one of the very few that does that. I find that my colleagues are intimidated by science. Yet, we know, as teachers, we know our children need to get hooked on science early; yet, we have no mechanism for doing that. And we know that if we do not do this at the elementary—if it does not start here, that they are not going to choose careers in high technology, in space, in computers later on from a vacuum because they are not going to have any base to build on. At best, when science is taught, it is descriptive at the elementary level. There are no labs; there are no experiments.

And in some ways, we simply are so ill-equipped. We do not have anything. We have no test tubes. We have nothing. We do not even have magnifying glasses—let alone anything else. We find that the only way we are teaching it at all is to do it descriptively, is to do it using problem-solving activities with children and developing our units. There really is very little out there for us to even use.

We find our teachers, when we try to entice them into doing—into coming to science and services, that they are into whole language. And our teachers do a wonderful job at language arts and they feel elementary—that is the place for language arts. The only way I have been able to get our teachers in Montgomery County at all interested in science is to integrate it across the curriculum using as the lure literature. Science and quotes through literature to develop science activities that are taught through literature that teachers can go back and use with their children. Otherwise, they are not comfortable. We really feel—I think we have felt for so many years that we have gotten the trickle-down effect. From colleges, then from secondary, from upper elementary, even all the way down. We really feel that we need some restructuring. Maybe this time, it is time for bottom-up changes. Things need to start from the beginning.

And I know that you at the secondary level complain how—what poor skills our children come in with. Yes, they do because nobody has ever given us an opportunity to structure it the way the children learn best. We know they learn from hands-on activities. We know that they can learn and we know what activities to work with, and we are given no opportunity to have any input in on the curriculum. I guess we really feel the changes need to come from the bottom up.

We need to give teachers more—a chance to give more input on programs that are being developed. We need teachers—more committees. We need more development of the SOLs that better reflect what is being taught in the classroom. And we need to give those teachers in-service. We keep getting programs. We had one with foreign language that we were supposed to do in the elementary school. I mean, on top of so many other programs. But yet, we know that if they—they may learn it well in first and second grade, but when are they going to use it again? And things like

that. We are constantly getting—being bombarded. We counted. In the last three years, we have had five new programs introduced and we have had in-service on one, where there is simply—there is not the money to adequately train the elementary teachers to use the programs that are in the schools.

It is not that teachers do not want to teach science; they do not know how to integrate it, to put it into the existing curriculum. We need to develop programs that teachers can use across the curriculum where they can use the literature, where they can use the whole language—these language arts that they are good at and be able to use that as a base so that teachers are comfortable with it and so that they will use it.

Thank you.

[Applause.]

Mr. TAYLOR. There is a gentleman in the back.

We have got about ten more minutes. And I wish we had an opportunity to work everyone in that would like to say something, and I apologize if you do not get the opportunity. At 2:10, we are going to go with "Improving the Learning Environment for Science Education." Hopefully, within there, you will get some built-in time for questions and we can keep on this dialogue that we are having.

STATEMENT OF EVERETT SWEITZER

Mr. SWEITZER. Mr. Chairman and members of the Committee. I am Everett Sweitzer. I am probably the senior educator here, having been in education 37 years, and the last 23-1/2 years in southwest Virginia. Currently, I am an eighth grade science teacher at Tazwell Middle School. However, my career has not been in the classroom. 1966, I was state math science supervisor under NDEA, Title III.

And I have to say that the impact of federal funds—this first federal program in 1960 was focused on equipment. And I saw the improvement in the schools. We are still seeing today—some are NDEA, Title III; some are ESDA, Title III. But we still do not have enough equipment and we need repairs of it.

I want to say something about the Dwight D. Eisenhower State Math and Science Education Program which has been useful to school systems. Some equipment has been purchased with that, but we still need more equipment. The second emphasis of the federal program has been on education. And the National Science Foundation has led that area, as with the U.S. Office of Education and I have benefited from both such programs.

But I think the best benefits have been from the Eisenhower program that has provided funds to the local school division for their own individually developed programs. At the local level, all teachers can benefit; however, I have read that the 1993 federal budget change in Eisenhower program funding requires that in-service programs be a minimum of 20 days or longer. This will limit the teacher participation. Most school divisions do not have provisions for 20 days of in-service. And in that such training is not directly related to the local school division program, most teachers do not have the time or interest to participate.

Please do not bow to the pressure of higher education for such funds to be entirely directed by college and universities. Such programs have their use And as a former college professor, I had a number of years of NSF grants directing programs. However, I found the most effective programs were those that were written specifically for a school division—working with a set of teachers, rather than the programs where people come from a number of schools. Now, we have benefited in our division by having a number of teachers go to VPI for programs, and that is very great. They bring back some good things. But it does not have an impact on the total school system. One teacher in his or her classroom makes a little difference. But unless you have additional equipment and involve an entire faculty staff, you do not get change.

So I urge the continual funding, particularly of the Eisenhower program, to include local divisions and not have it funneled off where you have to negotiate with a college or university to have teacher training. I think the teacher training should be designed by the local school division. They then can go to an outside force.

I just want to say something about Joe Berry's comment here—vocational ed. All of the years that I have worked—certainly back in the 1960s in the State Education Department in another state, a New England state, I always tried to emulate what was going on in vocational education. They have had the best long-term success of any educational program. Their focus has been on outcomes of their clientele and the fact that those teachers are employed 12 months a year and that they get new equipment updates, I think we need to take a long hard look in science education to this. I know I wrote a proposal to my Commissioner of Education some 30 some odd years ago proposing for the particular state I was working for that we do just that. I said we do that for all of our vocational teachers in the state. Why can we not do it for our science teachers in this state? Well obviously, you know the State Board of Education did not buy it because there were no funds. There were no federal funds for it.

So, do consider that in your deliberations. Thank you.

[Applause.]

Dr. WILLIAMS. Two quick comments. I agree with you that a locally developed in-service program is preferable to one that is operated for a few individuals on an episodically structured basis. However, the local program should derive—I think in contrast—in all due respect to the 1960s, which I do not—I was not a participant, but I do not hold in as an exemplary fashion as many people do. I think it is a period in which, retrospectively, there were a lot of antidotes. It is very difficult to understand what was accomplished. A lot was. But even if one can understand what was accomplished, I suspect most people do not know why, which is probably just as bad.

But what I was going to say, if a school system has decided, in the context of 2061, conceptually, programmatically, intellectually, this is our—this is what we are going to do. Here are the standards—whether they are ECTM or science. Here are the equipment and other resources we have available. Here are the constraints. And against those—all those other identified variables, we are going to now going to do X in-service for Y purpose to achieve goal

Z. Yes, it is best. But until we do the total experiment, right now, both of them are distinguished by their imperfections.

Mr. TAYLOR. Okay. We are going to go to panel one of our program now with Mr. Tom Haskins from Eastman Chemical in Kingsport, Tennessee and Dr. Michael G. Basham, Superintendent of Schools in Scott County, Virginia.

STATEMENTS OF DR. MICHAEL G. BASHAM, SUPERINTENDENT OF SCHOOLS, SCOTT COUNTY, VIRGINIA; TOM HASKINS, EASTMAN CHEMICAL, KINGSPORT, TENNESSEE

Dr. BASHAM. Congressman Boucher, we thank you for the opportunity to come here today and to tell you about our partnership. This partnership is between Eastman Chemical Company and the Scott County Public Schools. With me today is Mr. Tom Haskins, who is in management for Eastman. He is in charge of educational initiatives. And also with me, we have Mr. Danny Dixon, who is Director of Instruction for Scott County Schools, and of course, he is up in the booth coordinating the things that go on the screen.

Also in Scott County, we operate with the philosophy that we bring our people with us in whatever endeavor we become involved with. For example, this will be on our channel 30, which is the local educational television station, because we feel like that if there is any kind of improvement that is going to take place in education, your people have to go along with you or it is not going to happen. So in every opportunity that we have, we let our people see what we are involved with, on our channel 30.

Now our partnership established the channel 30 operations. The young people that are operating the equipment are in our television production class, which is a class at the vocational school.

We, in Scott County, were interested in the partnership with Eastman because we saw them as a resource that could provide invaluable assistance to us as we worked to revamp our science programs. We recognized back in 1989 that our approach to science was too content focused and did not do enough to properly teach the scientific methods of investigation, data collection and evaluation. Since that time, we have been working hard to change this situation.

Through our partnership with Eastman, many exciting opportunities are becoming available to our students and teachers that otherwise would not have. This is just another example of how much more can be accomplished when we drop the burden of traditional thinking and begin to ask, "Why not?"

Mr. HASKINS. As a representative of Eastman Chemical Company, I, like Dr. Basham, certainly want to thank Chairman Boucher and those who enabled this opportunity for us to come and share a little bit with you today and also to learn from you in this opportunity that we are vitally interested in.

A little bit about Eastman Chemical Company. We are a division of Eastman Kodak Company. The company efforts at Kingsport, Tennessee, that—as you can tell from this slide—extends not only in Tennessee, but into southwest Virginia, and our partnershipping effort is Tennessee Eastman Division, which is a division of East-

man Kodak Company. And our basic materials we produce there are fibers, chemicals and plastics.

Eastman Chemical Company, as a whole, has been involved in public education for a number of years and has done a number of things not only to support public education, but higher education as well. And I think, like many other major employers, we probably for a number of years, focused more effort in higher education than we did in public education. So we have looked at what do we need to do? And I think we can more clearly see as we get into a more global environment and we look at the business demands upon our employees. What they are going to need to know in order to be able to manufacture the products that we have and to provide the quality of services that we need to provide on a global basis. We are going to need to have more knowledge, skills and competency than we probably ever have had if we are going to sustain ourself.

I think our employees are going to need to know more complex and new technologies than ever before. They are also going to be expected to assume more responsibility in the job than ever before in the past. Layers of management have been reduced. We are looking at a more empowered work force, and more responsibility is going to be placed down on employees who leave public schools and move into the work force where those people are going to be expected to and accountable for making very significant decisions relative to the quality of a product, the service that goes into providing service to a customer.

And I think we realize that basically, the fate of our business and literally the fate of America rests in the hands of our classrooms and our schools today. We saw that our involvement in education was pretty much of a natural thing. We believe that we, as a company, are going to serve from the benefit that you folks in public education are going to provide to employers, such as we. And we felt that we had an obligation. Not only an obligation, we felt like that we could not wait for somebody else to do something that maybe we ought to be doing ourselves.

And so, that is the reason we have made this extension of a partnershipping effort. What you see here is to be four school systems—three in Tennessee and one in Virginia.

I think as we looked and assessed ourselves—which we felt was very important for us to do—we came to the conclusion that the areas in which we probably had a skill or a competency that we believed we needed to sustain, we also believed that maybe perhaps the things that we could do to add some value into the educational process really stemmed in three areas: math, science and technology—exactly what we have been sitting here talking about all morning.

I think we have received very enthusiastically from our employees in our company, the general public in which we have interacted with, and particularly educators, have been extremely positive and very heartwarming as to the fact that we were interested in becoming involved and would be willing to provide some human resources, as well as financial resources in this area. I think it leads us to the point that we are excited about what we see down the road, and we also believe—we are excited about what we jointly—

these four school systems and Eastman Chemical Company—what we believe we can accomplish in the future. And our whole role and our whole effort is to support these professional people in ways we believe that we can make science, math and technology education in the future extremely exciting for students.

Let us take a little bit of time at this point to share a video with you, give you a little bit more of an insight into this, and perhaps will give a little bit clearer viewpoint of why we are doing some of the things we are doing.

[Whereupon, a videotape was shows as follows:]

VOICE. "Education is important to the growth of our community and our company. Tennessee Eastman Division has begun an educational initiative and is forming partnerships with four area school systems to help ensure a capable, well-educated work force for the future."

Mr. HASKINS. "Four school systems that the Kingsport side has identified that we would like to partner with are Kingsport City Schools, Stoneham County Schools, Hawkins County Schools and Scott County, Virginia. And we had a team of about six people at the Kingsport site that will be hopefully working with a similar team of size in each of these school systems."

VOICE. "Math and science will be the major focus of the initiative in an effort to prepare today's student for tomorrow's work place."

Mr. HASKINS. "As we get into new markets and into new arenas of business that we will need to have a greater and greater level of competency, which these basic skills will allow us to be successful in this type of business."

VOICE. "An exotonic reaction always releases energy, and it is generally in the form of..."

VOICE. "The education initiatives will be good for Eastman as the company continues to grow, and it will be good for the community as well."

Mr. HASKINS. "We believe that becoming involved in a public education initiative such as this, that the quality of living or the quality of life that will be the result of such an effort will be greatly enhanced. We will find that—I think that the per capita income of our work force population in this area probably will be not only sustained, but will probably grow. I think the knowledge, skills and capabilities of the work force in the Kingsport region will benefit as a result of this."

VOICE. "Many Tennessee Eastman Division employees will have an opportunity to consider that their time and talent surely will be initiatives."

Mr. HASKINS. "I think initially we sort of set a goal that we would like to see five percent of our work force population here in Kingsport involved in such a process. I think we can see people like our laboratory analysts, our maintenance mechanics, our chemists, our engineers—any type of employee in any segment of our business—I think we can see those people being involved in a classroom where they will be taking real work experiences in the classroom and sharing with students in that classroom what the world of work is like."

VOICE. "Exciting times lie ahead for Eastman men and women as we enter this new frontier in education."

Mr. DIXON. "I am very excited about the opportunities that this partnership with Eastman presents. Obviously, Eastman has much to contribute toward enriching our math and science classes, helping us shape our vocational classes to be more in line with the needs of modern day industry, et cetera. We also see many opportunities for joint staff development activities. Eastman employees as guest lecturers in the classrooms. But probably the most exciting opportunities are as of yet unidentified and awaits the joint meetings of Scott County and Eastman employees in working out the possibilities that exist before us and ensuring that this partnership is a success."

VOICE. "At Eastman news break, this is Mike Horner, reporter."

[Whereupon, the videotape was concluded.]

Dr. BASHAM. Our partnership is still in its infancy. At this point, we have primarily concentrated on building the necessary structure to support and guide it as it develops.

Some of the activities we have conducted thus far—we began with the selection of school divisional and Eastman Partnership Steering Committees. Baseline data on science and math participation and other relevant indicators were collected and assimilated. In-service workshops were shared among Eastman and Scott County teachers. Tours of Eastman Chemical Company were provided for central office staff members, principals and guidance personnel. Eastman engineers served as speakers at secondary and middle schools. A survey of science teachers and principals of partnering divisions was held to obtain ideas for improving science instruction. Eastman provided experimental science kits to enhance middle school science instruction. In science instruction, we have a strong belief that hands-on activities are important and that, of course, learning by doing is very important, especially at the elementary level.

We are excited about Eastman's sponsorship of a Scott County science teacher in the Chemical Education for Public Understanding Program at the University of California at Berkeley. And this teacher will be attending this this coming August.

Mr. HASKINS. As Dr. Basham has said to you, our program is in its infancy and it really is. I think some of the things that he has highlighted here is things that we are already involved in. And I think we are sort of excited about the potential that we see. The opportunity we have had to interface with our employees and the public and teachers, as I said earlier, has been—has been pretty exciting to us. I think these groups of people have involved themselves very enthusiastically, have volunteered to become involved. We are beginning to see parents who are beginning to say hey, I would like to become involved.

When you heard—the tape mentioned something about five percent of our work force population. To give you some sort of feel for that, the size of our plant is 12,000 people, and we are looking to have a minimum of 600 people involved in this educational process within the next 12-18 months. I really believe, based on the initial response that we have already gotten, we probably will exceed that number pretty significantly.

We had an opportunity—you saw some boxes that just appear to be stacked up against the wall, and you might wonder, well, what

in the world are they showing that slide for?We had a public educator who worked in our employment one summer, came back another summer to work for us and really designed some science packages—which I will mention again in a few minutes—that were geared toward fifth and sixth graders. A public educator did that in our employment for a summer. He also happened to have the opportunity to present his works and so on at the National Science Teachers Conference in Boston, Massachusetts about a month ago.

So, these are things that we have provided some training and understanding with to the public educators in this partnershipping effort. And they have now taken those science kits back, which represent about 15 experiments and demonstrations to use in their classrooms.

Let me go on and share a few things that came out of a recent opportunity we had to meet with some middle school principals and science teachers. Now—I do not reckon I can get this thing off of here—but anyway, what we did was—things that you are going to see on these slides, we have not modified. These were ideas that came out from those educators—the ways that they believed the things we might do to enhance a partnershipping effort to improve science, math and technology education in this partnershipping effort.

This summer's science challenge program is an opportunity that we provide for teachers to come in—science teachers and math teachers—to come in and work in our company in the summertime for roughly about ten weeks. And they are given a job, just like anybody else is given a job, that they are expected to perform certain results and outcomes. But they have certainly an opportunity to learn our company, see very high technology, utilize existing equipment. Also, they are going to have the opportunity, in most cases, to interface with some of the students that have probably matriculated through their school system, and they are going to see out there now in the work place what those former students—now Eastman employees—are doing. I think it will also give them an appreciation for what students really are expected to do when they get into the work place.

Our visiting scientist program is nothing more than Eastman men and women across many fields, but if I look at—again, in the math, science, engineering and technology fields—that schools are wanting to use into the classroom. Where we are providing opportunities for teachers to learn, through summer science experiments or we are seeing opportunities where not only the teachers, but the students themselves can come into the work place in groups to really see the things that you all are trying to teach them in the classroom. Again, this is in the supportive efforts to bring the real world to life that will support what you are trying to do.

Looking at what can we do with respect to lab enhancements. These are some things that maybe you, industry, can do to help us in evaluating our laboratory equipment and maybe even repairing our equipment or set up some kind of process where this is regularly done.

There is also some thought about equipment availability that we might have and no longer use that could be effectively utilized by a school system. And even a thought, an idea came up that we might

even set up sort of an ECC school—science school that would help in some progressive learning or professional development, not only for teachers and administrators, but maybe for students as well, and there is another slide that you will see that makes a little bit of reference to this later on.

Just a list of resources that could be provided to schools that they might be able to bring this professional expertise into the classroom or at least be able to make contacts with those people to enhance the learning process.

Portable labs—maybe we could put together a portable lab that could move about among these four school systems that would be able to provide and enhance the greater learning opportunity for a greater number of students.

One educator was extremely interested in—as we look at some of the things that we are doing in quality—what we call quality management and performance management and new things that we are doing—look to see what we could do to help facilitate the capability for change—methods. Changing some mindsets, encouraging and promoting team work, which is something that we are going to see very much in the work place. We are not looking so much for individual achievement as how people are going to be able to interface and work together in teams because we cannot be a bunch of individuals out there. We have got to work in teams, and if we do not have people that are going to do that, they are not going to be able to retain their jobs very long.

Science computer rooms—again, some technology applications to promote science through technology advancement.

More parent involvement. And look again, this ties back with my five percent number of how we can utilize people in all walks of life. If you take a general mechanic or a lab technician and the math and science those people have to know, just in the performance of their jobs on a day-to-day basis. And most of those people are parents. They live in communities where schools exist. Their children are in those schools. We need to get some involvement there because I agree with the comment that was made this morning about we cannot turn our child over to you educators when they are six or seven years old, and when they graduate from high school, see what kind of return on the investment you gave me because I am a taxpayer. We have got to get these involved and I very clearly support what you saying in that respect.

Maybe we could set up something like an Eastman Day where we could have some competition among students that based on some kind of criteria, they could earn a day to be at Eastman.

Mentoring. In some way, I think trying to interface with people in chosen fields of interest to students. Maybe some students are having some difficulties in a particular subject matter and recognizing we all cannot be all things to all people, even though everybody expects you to. Maybe there is some way that other resources that have capabilities and competencies can assist. It is just amazing the kind of relationships that can develop and be very positive and help direct students to where they might want to go in the future.

Again, just using increased practical applications and understanding. We heard lots of this from this group of people, that this

is the way that they felt that companies like ourselves could help them in bringing practical applications to the classroom or really taking the class—the classes to the world of work.

Doing some things maybe through our guests here today from the National Science Foundation. What might we be able to do to interface with people like that to promote specialized kind of seminars to where we can do some things to help public education educators, such as yourself, have some opportunities for additional learning experiences.

One of the things—you can imagine here, we have got four systems that cross two states that have come together, and they say, you know, can we do more of this? Can we come together where we can share ideas, share experiences—both good and bad—so we can learn together, grow together, and hopefully, we believe that we can promote some things that will—really will enable our students of the future to learn more. Let us try to do more of this.

And I think Eastman demonstrating technology to students and teachers—we have mentioned this. Also, doing some things and helping them with curriculum review. The man at the back a minute ago—types of things that we are going to need and students are going to need to be expected when they get into the work place, so that it has that benefit to them.

Work ethics. What are employers looking for? What do we expect in the way of a work ethic and what can we do to help communicate that?

Looking at unit development, maybe there is a group of teachers coming together that they might come up with an idea. They might decide in one of these school systems as they work together to say let us pilot something like that and let us evaluate that as four school systems working together to see what the results of that come out. Monitoring, measuring and tracking that, and then maybe if it works out the way we think, we could institute that in maybe all of the other three systems or in some progressive way.

Let us meet regularly. Let us just do not do this when the wind blows hard, but let us set up some sort of regular sort of meeting schedule where we can get together and do these types of things.

Provide films, videos and slides that might help in the learning process, that might help to identify for students what really a chemical engineer and chemist, systems analyst or somebody like that—what they really do and what they have to know to even qualify to get into those fields because of them really do not have any idea.

Career opportunities. Again, what employees do. That is not only the professions, but also, I think the people who are in manufacturing operations.

Let us use these professionals in classrooms.

What about equipment availability? Maybe providing some of this to schools as we have no longer a need for it.

There was a fellow that said, you know, we need in our physics area—it needs a lot of improvement, and we do not have many practical applications that we can bring to the—to this physics class. What can you do to help us there?

Laser technology and understanding as, again, a piece of technology.

Create a science center. I mentioned something like that a little bit earlier.

Portable labs for elementary. One of the focuses that we are having in this whole thing is we are really starting our focus there because we have an interest in pre-kindergarten, in K-12 and in life-long learning, both for our employees and for educators, and what can we do to provide enhancements in long-term understanding? But we really want—we need to start something more to get children ready for school which is going involve the total population—parents very much in this process.

Math, science and teachers working together. I heard people mention today, you know, rather than working out here at separate entities, what can we do to start working together and integrating some of our curriculum?

The next slide is probably going to advance that into general and life science areas.

What might we do to do some things to have some rotating lab experiences, particularly in the elementary schools? And these are some things that we are working with our public educators on right now in trying to do some things at the elementary level to provide some hands-on and real practical life understanding.

Let us benchmark with some other countries. Let us really look at what they are doing, who they are testing, how they are tracking it. Let us do not talk about it; let us really get some information out there and let us sort of track where we are and where we are going.

Utilize retirees. We have got a lot of people in this community, and as our country gets older, our community, in particular, is getting older. I think we have got a valuable resource out there that we can tap, that very much is interested in education.

And last, there was an idea that maybe we ought to have something like a Super Saturday, and I am sure lots of you all have had that. But it would be something that would be focused more toward the K-3 grade levels that would hopefully, again, involve parents, educators, business and industry and students to help promote interest in math and sciences.

These are a few of the things that, through our intervention with the people we thought it might be of value to, to share some of the kinds of things that we are going to be working on. We have got a long way to go. We are looking at this not being something on the short term. As we have entered into these partnerships, we are looking at a 10- to 15-year period of time that we are going to be looking at working with these particular schools.

We appreciate the opportunity that Dr. Basham and I have had today to share with you concerning the Eastman Chemical Company/Scott County School partnership. And if there are any questions that any of you all have at this point in time that you would like to address to either one of us, we would be happy to try to answer it if we could.

Dr. BASHAM. Also, I would like to—while you are thinking about a question, I would like for someone here to volunteer to help Mr. Pat Johnson out. He is in our charge of our television production class, which as I told you, this film will be shown on channel 30 and on the Eastman network. We would like to interview someone

so you can react to this presentation. And we would like for you to do it at this time. Naturally, we would like for it to be positive, but you can say whatever you want to say.

And of course, you know the rules about any time you appear on TV, is always look at the person holding the microphone or asking the questions. Never look at the camera. And also, you never say, "No comment"—and smile. And if you do not know—if you do not have any idea what you are going to say, start talking about George Washington.

Mr. HASKINS. Mike, are you a teacher?

Dr. BASHAM. I think so.

Mr. HASKINS. Full of instructions.

Dr. BASHAM. If anyone would do that, I sure would appreciate it. And I tell you what we will do for you, we will send you a tape of this whole thing, and you as well, if you just give us your name and address if you do that.

So, someone help us out, please.

Mr. HASKINS. Any questions?

Dr. BASHAM. He will be right out in the hallway.

Mr. HASKINS. We thank you very much.

Dr. BASHAM. Thank you very much.

[Applause.]

Mr. TAYLOR. Panel two in our program today is "Enrichment Programs for Science Teachers," and I would like to introduce Mr. Dale D. Long, Associate Professor of Physics from Virginia Polytechnic Institute and State University, Blacksburg; and Mr. Harvey Atkinson, Science Teacher from Rural Retreat High School in Crockett, Virginia.

STATEMENTS OF DALE D. LONG, ASSOCIATE PROFESSOR OF PHYSICS, VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY, BLACKSBURG, VIRGINIA; HARVEY ATKINSON, SCIENCE TEACHER, RURAL RETREAT HIGH SCHOOL, CROCKETT, VIRGINIA

Mr. LONG. Well, let me change plans then and get Harvey to put my transparencies on.

I would—the comments I want to make today in regard to—or based on the experience we had with our NSF funded program, Physics and Physical Science Teachers, A Model for Excellence, who Tom Teats and Donna Conner were the other directors, in addition to myself. It is based on this program, the most recent one, and then, other programs that were funded through the State Council of Higher Education for Virginia.

Harvey, would you slip the next one there. So based on that, what I wanted to talk with you about a little today was a plan for enrichment of science teaching. It looks a bit blank at this point, but you see, I have a square there labeled "classroom." And the things that we tried to do in this program were focus on what would happen in the classroom. So for a few minutes, I wanted to fill in the blank space with the elements of our program that would influence what would happen in that classroom.

So first of all, let us start, if we could, with—I am going to stand around here where I can look—start if we could with what the

teachers need. And I brought along a little bit of technology here. It is a little bit faint from this distance. But the primary thing that we found when we were designing our program, we thought about what we should do about the nature of the content of the program. This was a program, by the way, for middle school and high school teachers who either needed some refreshment in physics or physical science teaching or who were teaching other sciences and wanted to come into this area. And we thought about should we teach the course that they will teach? Should we do enrichment type things, focus on specific areas? And we settled instead on basic content knowledge as the initial focus. And we had some people—several of our teachers here—Ken Matlock over there wanted to leave after the first week when he saw how hard we were hitting with basic physics. But I think most people came around to believe that was the thing to do.

But not only in the content knowledge, how that relates to every day experience. What is the relationship of this physics in our case to the lives of the teachers and of the students that they would be teaching? Then, they needed instruction in teaching activities, by which I mean they needed to be taught by example, is the approach we took. How to do classroom demonstrations. How to develop classroom demonstrations. How to develop laboratory activities. Exploratory activities. So, instruction in that. And finally, knowledge of resources. There are a lot of resources out there, as someone has mentioned earlier—others have mentioned earlier today. Teachers need to know where to find those, and we tried to provide the opportunity for that.

Now putting all this together then, they need an opportunity to develop these demonstrations—develop these laboratories. And the practice—to present them to each them and get feedback. And we provided that in our program.

So in addition to those things that we could provide—Harvey, if you would slip the next one up—another very important aspect is the support of the teachers on the part of the teacher's administration. Obviously, there is the need for financial support for equipment and that sort of thing. But perhaps even more importantly that teachers understand the financial situation today—perhaps more importantly is what I call professional support. And this has been talked about by Mr. Taylor and others. Teachers need the opportunity to develop professionally, to lead workshops themselves. Our program required all of the teachers to lead at least two workshops for other teachers. And they need the support of the administration in being able to do that kind of thing. They need the support in having the confidence that this teacher could do something. We visited all of the schools—Tom Teats and I visited all of the schools of every teacher every year and talked to the teachers, visited the classroom and talked to the administration. And there was all—a broad range of support for teachers from their own principals and administrators—everything from the principals who just did not care to a school in the eastern part of the state—a big school that had the nicest facilities that you could—any teacher would dream about, but the administration was so oppressive in looking over this teacher's shoulder and not giving her any support, that she is now selling life insurance.

So all of these things together and here is what we found happening in the classroom as a result of this. As we visited all of these teachers and tried to find out what made a difference in their teaching, the thing that kept coming up was this word "confidence." As a result of content knowledge and knowing how to teacher, the teacher had confidence that they could present the material, the discipline problems were much less because they now could talk about the area, have various interesting activities and the kids were involved and they did not have the discipline problem. They were free more to explore, rather than just to present facts. Again, these ideas have come earlier today. We talked to—one of the teachers we visited after the second year of the program said, I went back and compared my lesson plans this year with those for two years ago, and it is just amazing how many fewer topics I covered this year because we explored things in depth, rather than just not presenting facts. And so, there is a lot more exploration; there is a lot more use of technology.

Harvey Atkinson is going to talk in a few minutes. He is one of the teachers in our program, and he has been a prime example of the use of computers in his teaching and instruction. His administration, for example, here is a rural school that is very supportive of what he tries to do and gives him the freedom to do it.

And another impact is the connection with other disciplines. We heard about the need from the elementary schools in writing and that sort of thing. Teachers with this kind of confidence that has developed from knowing the background material are also then free to interact with other teachers and other disciplines.

So all of these things are things that we found happening with our teachers—even the ones—the more experienced teachers. We asked them what was the most useful part of the program, and again and again, they cited the basic knowledge of physics, even though these were teachers who had been teaching and had a good knowledge to start with.

So what do we hope to come out of this, if we can put one more thing down through the classroom line there. We have evidence that this is happening. We can only speculate, but we are reasonably sure that what is going to come out are going to be students more turned on to science, students who can apply science in their lives, how it reacts—how they interact with science in their everyday living. And of course, not all students—but some students who will go on to major in science.

And so, as an example, Harvey is going to take over from here.

Mr. ATKINSON. Good afternoon. I do not know about the rest of you all, but I am saturated. I have heard a lot of wonderful things, a lot of interesting comments, a lot of concerns; and I do not know about you, but it is going to take me awhile to digest this and take some of it back to my school district.

I am one of two teachers from the Wythe County School District that is here today. The thing was advertised throughout the county, but in Wythe County, we start exams on Monday. And teachers are preparing for exams and principals—although many of them support this activity—are a little concerned to turn loose a large number of their science teachers the Friday before exams

begin. So, while there is support in our county, they are not all here today for that reason.

I would like to tell you just a little of my background. I can associate somewhat with what Mr. Able said. I graduated from high school back in 1961, having taken maybe one or two courses that I used later on. I would say that the course that meant the most to me in high school was Latin because I learned a little English. I learned how to communicate. And I have found in my 30 or so years since high school—40 years now—that maybe the most important single thing that I learned how to do in high school was communicate.

After I got out of high school, I went to VPI for about four years in Animal Science, and then joined the Navy because Vietnam was big time. And so, I spent 20 years in the United States Navy as an officer, coming up through the service line, finished in 1986 and retired from command of a ship. Came to teach because I saw young men and young women in the Navy who could not succeed. They could get in; they could advance a little bit; but they could not succeed because they could not read and they could not think—they could not reason. They could rote memorize; they could regurgitate large volumes of facts if they could gather them from somewhere, but they could not use them for anything. They could not put two things together and they could not read the material that they had to read to learn how to advance.

Now that is what brought me to teaching. I came back to the state of Virginia where my wife's family has been for 150 years and went into the business of trying to learn how to be a science teacher in middle school. I spent a year and a half in Virginia Tech learning how to be a teacher and what I—the one thing I learned in that year and a half is that it takes a lifetime to learn how to be a teacher. You do not learn how to be a teacher in a year or four years or six years. And you do not learn it from another teacher. You do not learn it from an instructor in college. You learn it from students. At least that is where I am learning how to be a teacher.

Along the way, though, it helps to get support. One young lady from the Radford Schools here this morning commented on the need to talk with compatriots—with contemporaries on a regular basis. Dr. Long's program provided me and about 20 of the rest—20 other teachers with that very opportunity and provided us the wherewithal to do that after we left Virginia Tech. We formed, among other things, a computer network that, unfortunately, I understand dies this month. That particular network was funded by the NSF as part of the grant to set up this program, but when the money for the program runs out this month, that particular computer network runs out. But Virginia—for those of you—I hope all realize that there is a computer network in place in the state of Virginia that costs you teachers nothing if your school systems will put you on the network. And the Virginia Public Education Network is, in fact, a way—it is not real-time communication; it is not telephone, but it is the next best thing. It is a way to leave a message for another teacher, a question, a comment, and get an answer back, as long as that teacher is also on the network.

So there are some good things going on in Virginia—some things associated with this particular program that I would like to carry

on with. One thing, one gentleman commented on the fact that we need individual schools to be totally committed to an NSF program or somebody's program and not a program that takes teachers from a large area maybe. I found this to be a Godsend to me and I took many of the things that I benefited from back to Wythe County and have done not one or two workshops, but several workshops for individual teachers—one or two teachers at a time if that was who was available. And we sat around and talked and worked with pieces of equipment that we were able to scrounge from one school or another.

The Wytheville Community College, a sister organization to New River, has been very good to us in sharing equipment. Yes, it would be nice to have all kinds of equipment right in my school where I could lay hands on it any time I want it or need it. But until that happens, there are assets. There are resources out there, and this program was instrumental in helping me as the teacher find those resources that otherwise may not have been available to me only because I did not know where they were, did not know how to get my hands on them. Having learned that from people like Dr. Long, I can take it back and share it with the teachers in my county and I believe that it has had a positive impact on science teaching in Wythe County, not because I am a great workshop leader, but because people are willing to learn if somebody is able to help them share, find the information and get with it.

And I would like to finish up my comments with something else that Mr. Able said about information. The world is full of it, and it is coming in great buckets everyday now, particularly in the world of science. And I think the biggest thing that we, as science teachers, can do for our young people is not cram their heads full of individual pieces of information, but help them figure out how to find the pieces of information that they need and help them develop a process to solve the problems that face them in their life and in their jobs and in their communities at home.

At this point, I would be happy to entertain any questions about this program, or I guess we can on with comments about science teaching in general.

Mr. TAYLOR. Okay. I have been asked to keep the conference—try to keep it on schedule, and I do not know if I am doing a very good job of that so far. But to keep it moving here. Let us go ahead and go to the demonstration, "Chemistry in the Classroom." This demonstration is by Ms. Ann Benbow of the Office of Pre-High School Science, American Chemical Society, Washington, D.C. And she will be doing an interactive demonstration with audience participation.

STATEMENT OF ANN BENBOW, OFFICE OF PRE-HIGH SCHOOL SCIENCE, AMERICAN CHEMICAL SOCIETY, WASHINGTON, D.C.

Ms. BENBOW. There are a few of you left. That is good. No one left during the day.

Hi. I am Ann Benbow from the American Chemical Society, and my job there is to coordinate the Office of Pre-High School Science. So that is for elementary and middle school science, and I have been listening to the various kinds of problems that folks have.

And what I have come to offer today are a couple of suggestions, a couple of answers—things that we have been working on. We have a couple of National Science Foundation grants and we have some money from dues-supported programs at the ACS. And you are receiving one of our products right now.

Do we need any more? Okay. They are going to get some from the other side. He is coming back around.

[Brief pause.]

Actually, I am not much for demonstrations. We are going to be doing later on just a very small hands-on activity from one of our magazines, from Wonder Science, just to kind of charge you up at the end of the day—something that you can take back home with you and say, we found one thing at the hearing to bring back to school. So I thought that might be fun.

But these are some of the programs that we have at the American Chemical Society that you may not be aware of. We are finding that one of the main problems that we have at the ACS is getting the word out. We have a lot of wonderful things that many folks do not know about them.

So, the first one up there on the list that you are receiving is Wonder Science magazine for upper elementary and middle school children. It comes out eight times a year, and it is a result of a partnership between the American Chemical Society and the American Institute of Physics.

So there is one thing that we have got for you. And if you would like to have some money to do—I just saw everybody perk up—to do non-formal or informal science, parents and children for terrific science, then you can get some grant money from us, and it is really easy to get—a very small application—only five pages. Not the application—the whole proposal is only five pages. And you can get up to $1200 a year to do a program with the 4-H, for example—which we are very strongly in favor of—with museums, with parents who come in to work with you. Very easy to get. And the next grant deadline—which everyone always likes to write really fast—is September 30.

And the funding rate for the amount of proposals that we get—the amount that we can fund—is usually about 70 percent. So if you send one in, you have a really good chance of getting funding.

And I can send you one of these little books. I have a toll-free number that I will be giving you later on, and I love to get phone calls. Just call us up and I will be glad to send this to you. This is called "PAC Facts." It explains the program; it has a grant form in it and it lets you know how to get some money from us.

You have seen the Wonder Science there right now. You see it uses very common, ordinary materials, and now, we have a Spanish language version one. So if one of the goals of your program is to incorporate some cross-curricula stuff, some multi-cultural information, then we do have a 32-page Wonder Science in Spanish, and it is free. All you need to do is contact us and we will send them some of them to you. And we work with the American Association for the Advancement of Science on that.

We also have a videotape package, "Tracing the Path," describes the achievements of African-American scientists and adventures. It is a 20-minute long tape and it comes with an activity package, so

that is something else that we have for you. We are trying to do work in as many areas as we possibly can to produce materials where we see a need.

And the last one up there, "Science with a Scientist," is a program that we have developed with the Smithsonian Institution. We have scientists from the National Institutes of Health and other organizations who come down to the Smithsonian and work with us to learn to work with elementary students and teachers in a more productive way. So I have information on that, and I would be glad to send you that also.

We worry about folks who are wonderful scientists, but maybe are not that wonderful with elementary children and we want to provide them with as much guidance as we can. So we also have a videotape called "Chemist in the Classroom," which is available for that same purpose. And that is further on down the list, I think, under "Teacher Training."

There are some curriculum projects that are brand new, and I think that you really should know about them. From what I have heard earlier on, you are looking for something that is issues based, cross the curriculum, practical applications, easy stuff to use, very engaging and lots of fun. Well, we have one of those and it is funded in part by the National Science Foundation and it is called FACETS, Foundations and Challenges to Encourage Technology-Based Science. I have some samples of the modules with me, and you are welcome to look at those later on. And I have a description of the project and it is up there in the front. So you can grab one on your way out. We have field tested grade 7 this past year, and we will be field testing grade 8 next year. So if you would like to be involved in that, just let me know.

This gives you a really quick description of FACETS, and you can see it is a Science Technology Society curriculum, and some of the main topics are things like, "The Science of a Shipwreck." You can take a look at solubility that way. And another one is on barrier islands—on erosion of barrier islands. Another one is on food additives, and the kids work with vanilla ice cream. Another one is on exercise, and they develop a videotape. So all of the laboratory activities that they do are all focused toward a particular end point or a particular project. And we are having wonderful success with it. Kids who never succeeded in science before are doing a very good job with FACETS. So I would be glad to talk to you some more about that.

And one of the other big programs that we have—the other one, I will tell you about very briefly is Operation Chemistry. Since there are folks in here who are elementary and high school and college people. Operation Chemistry is a national teacher training program in chemistry for upper elementary and middle school teachers. And we are currently developing and field testing workshop books for this program, and there will be a huge training of trainers session for 36 teams either next summer or the summer after, depending on when the funding comes through. And each of these teams consists of a person from college chemistry, a high school chemistry teacher, an elementary or middle school science person and a representative from industry who works with education. And each one of these teams will be around the country in

various regions. We will provide them with the books and the training, and their job is to provide training in elementary and middle school chemistry for teachers in their area. So that is coming up very soon. If you are interested in that, please let me know and you can put in to be a team if you would like. This is a perfect area for it with the industry and all of the other involvement.

All right. If you are a high school person and you have never heard of ChemCom, please get in touch with us and we will be glad to send you information on that. Chemistry in the Community is our high school curriculum. It is issues based also. And if you are a college person, "Chemistry in Context" is coming up very shortly. It is being field tested right now.

Does anyone have any quick questions before we do something that is just fun and gets you charged up a little bit? Would you like the toll-free number? All right. Are you ready? The part that everybody knows is 1-800 and then is ACS-5558. I will say it again, 1-800—it is like a commercial—ACS-5558. Now here is the trick, you do not want to get into the menu because it goes on forever. So once you dial in, hit zero. It gives you an operator, and ask for Extension 6179—6179. See, that is me. Then, once you get that, then I will get you whatever you want and help you out for information on any of our projects and we send out lots of free stuff, too, so that is a good thing to know.

Does everybody have a ziplok bag? Okay. You need to have a partner. Are you sitting next to somebody? Well, if you do not have a partner, it is okay. I mean, you can work by yourself, but it is nice to get to know some of the folks in the room. You have been sitting pretty close all day long, you might as well introduce yourselves. There you go.

And this is one of the activities from "Wonder Science" magazine and it sort of embodies everything that we like. It is cheap, it is safe. You are going to get to do a little inventing and designing. It has problem solving involved in it and technological applications. In that bag, you have got a balloon. So why do you not take your balloon out. Very good. If you have little bits of thing attached to your balloon, put them back in your bag because you are going to need them later on. Got it? If you do not have your desk out yet, you better take it out. Flip it up and flip it over. You will need to have a work surface. Very cooperative, are they not?

Okay. You also have in your bag at least one small magnet. And let me give you a hint. I bought a whole roll of those magnets yesterday at a craft store. They gave me about 30 magnets, when I chopped it up, 69 cents for the whole roll. If you need magnets, that is a great way to do it. Okay, take your magnets out and your balloon.

Now, the rest of the stuff in that bag is trash for recycling. And if you take a look at what you have got in there, you have got the source of materials that we recycle. What do you have? Plastic—what else? Foil, aluminum, paper and steel. Okay, those are the paper clips. There are actually two different kinds of plastic in there. There is one that is kind of thin and looks like plastic wrap of some sort. All right, that is special and you will find out how in a minute. And then, the other one is regular. Here is your job. I

want you to use what science knowledge you have to design a method for separating that trash. You have a balloon that you can use. Think about what can you do with a balloon? If you inflate it, you might be able to do something special with it. What will a magnet do with that mixture? You have got little cups of water—they are coming. When you have a little bit of water, what will happen with the materials in there?

So, work with your partner and come up with a method and let us see how you can separate your trash. No fair just picking it apart. That is a cheesy way out.

Okay, what did you find out? How did you get your paper clips out of there?

VOICE. Magnets.

Ms. BENBOW. Magnets—that is the easy one. What else did you do next? Static electricity picked up what? Okay, some pieces of plastic and some aluminum? Okay. How did you separate your two kinds of plastic?

VOICE. Water.

Ms. BENBOW. Water. What happened with the soda straws? Okay. And how about the other stuff? It not only sank, it dissolved. Yeah, it is polyvinyl alcohol. It is water-soluble plastic. They use it for hospital bags. You can throw dirty laundry in there, throw it in the washing machine and the bag goes away and your laundry is taken care of.

How about the foil? What did you do with that?

VOICE. Static.

Ms. BENBOW. Static, okay. What you could after this and what we recommend to the kids and their parents is make a flow chart for how to do this. And we have a really neat video disk that is not ours at ACS, but I use it all the time, and it shows using a great big static generator to pick up stuff. Using a large magnet to separate trash. It has got great technological implications for it.

So I just thought this would charge you up a little bit. You can take the magnets back home with you, of course, and your balloons. You can blow them up and have them in the car on the way home.

And please give us a call if we can do anything. If you would like to be involved in the programs, I would love to help you out. Thanks.

[Applause.]

Mr. TAYLOR. Okay. We want to thank the people from these panels, Mr. Tom Haskins, Dr. Michael Basham, Mr. Dale Long, Mr. Harvey Atkinson, and of course, Ms. Ann Benbow here, the Office of Pre-High School Science, American Chemical Society. And I think it would be appropriate to give all of them a big hand.

[Applause.]

Mr. TAYLOR. We are drawing to a close here. I was asked if there are any—is there anybody that would like to really make one or two final remarks in the next minute or two that they have really been a burning issue to them and it was not addressed. Would anybody like to make a final comment?

Okay, Mr. Mason.

Mr. MASON. Can I make it from here?

Mr. TAYLOR. Sure.

Mr. MASON. I would like to comment about the curriculum. I know that the lady in elementary was concerned about curriculum materials designed for a different purpose across the creek, and that sort of thing. I remember back in the 1960s that we had a lot of curriculum materials, but somehow, those things never really got implemented. They never really got into our instructional program. And I kind of feel like we have so much curriculum now that to spend millions of dollars on more curriculum development might not be the way to go. Although we might need some guidelines and some help on using the curriculum that we have more effectively, to go out and spend millions of more dollars and I am afraid that is the direction we may be going to develop a lot more stuff that would not be as well used, if we really put it back to the local teachers and let them do some development on what we got and give them some time and give them some resources to work with, they might make better use of the curriculum.

VOICE. What Mr. Mason is saying—

The REPORTER. I cannot hear you.

Mr. TAYLOR. Why do not you come up here?

VOICE. We are overloaded with curricula, but we are not overloaded with time, and this applies to science and all of the other fields. Our students are on a conveyor belt. They go five minutes to homeroom, 45 minutes to first period, 45 minutes to second period, 45 minutes to third period—all the way through seven period a day. They are changing mindsets every 45 minutes. There is a four-minute break between periods. They have to run to their lockers, get a book, go to the bathroom, get water, get into the classroom, and then, change gears. And we are overloading them with information on seven different subjects 180 days a year.

If we wanted to be logical about it, we should increase the time span in the periods and shorten the amount of subjects—to take those subjects in depth. Really teach them something about biology, not 5000 vocabulary words. But teach them a lot of genetics, a lot of—I do not know—plants. Whatever your speciality is, teach a lot of that and show them how to do it, how to solve problems in it, but do not try to do it in a 45-minute period 180 days a year. My kids come in to a class, by the time I get them settled down and get the roll and get them started, I have 30 minutes to teach, and then they have got to go again. And it is almost like a conveyor belt. We are cramming information in, but it is not going into their heads. It is just staying long enough to take the test, and then, move right on to the next topic.

[Applause.]

Mr. TAYLOR. Okay, for a closure, we will have Dr. Joe Exline make some concluding comments here, and I think they will probably tie in—and I hope I am not overstepping my bounds—but I think he will address just those things that you have brought up in closure here.

Dr. EXLINE. I was taking good notes today. I heard a lot of things that is going to be very valuable as we move VQEST forward.

There are several issues that you raised about—and the last one is a very appropriate one. You need more time to do more things. You need to cover material in depth and not try to cover the whole field of biology because you cannot. And so, what we are trying to

do with VQEST is to address those elements that have not been addressed before. Jack, you are right. A lot of things that we tried to do in the 1960s were never implemented. The reason—because we did not work on the system.

What I would like to leave you with here today—I am going to get a chance to use my transparencies because I think this summarizes it pretty well. And I want you to understand that we are trying to separate where we want to be with how we get there. And so, I want you to take a look at this first one. There were some handouts up here if you did not get them. There are still a couple left.

But one of the things that we have to look at the evaluation—the evaluation of this whole process. And over on the left-hand side, the ultimate aim is to turn out a better product out of schools. And what we are hearing right now is that we need students to leave schools that are problem solvers, critical thinkers, people that can take action, people that have some skills. And we have a way—and someone mentioned this—the test drives where we are going. And so, on the left-hand side, we have to set realistic goals for students—for all students. And then, we have to have some way to assess students and make sure they reach those goals and those objectives we have set. And I have got A, B, C, D, E, F. That could be 15—it could be 30 things. But what do we expect of students? We ought to have some way to measure.

Now it is okay if they achieve all of those things, and there is no problem if they achieve. But the problem becomes if they do not achieve. And that is what you just heard about our students compared to the Japanese, our students compared to other students in different places. So if they are not achieving, there is no reason to change the goals and the test if they are appropriate. What you have to do, you have to come over in the system in which we are working and we have to work on the system. And part of the system I am showing there is a pre-service and in-service and instructional materials—two examples.

So what VQEST—we have been in the school division for the last ten years and we have done environmental assessments. We are giving a report card to the system—not to the student—but to the system. And once we find out what the problems are, VQEST then is to remediate that. To bring those goals for pre-service and in-service or instructional materials in line with the goals we have for students. And then, I will bet you if we can put those kinds of things in place, we will be able to see student achievement increase regardless of what we looked at for student outcomes.

Another way of looking at this, it has got to set in the total context of school. One of the—one of our major goals, as you heard it here today—is to turn out a competent and effective work force. We are talking about—whether we are talking about the housewife or the rocket scientist, whoever fits into that total work force—that is a goal. Underneath that is a world class educational system. That is the process through which we will reach that goal. And that world class educational system would consist of a common core—something that we are all pushing for.

I have summarized that very briefly into developed skills, nurtured attitudes, relevant connections, essential content. We bring

that right down in the center of our reformat for mathematics and science. And you notice when we bring that down, we brought down nurtured attitudes, developed skills, relevant connections. If I work in language arts, I would do the same thing, except then, the essential content becomes language arts. The connectors become the important things that link the sciences together. It also links the sciences to other areas and links the science to the real world.

Now that is easy to say. We can say those kinds of things. We have been saying it for years. The secret to getting it done, then is to build a support system around where we want to go. So the six elements we are looking at in terms of that would be new pre-service models for teachers, new in-service models, new instructional materials—I mentioned some of those things this morning.

Jack, when we talk about community involvement, we are not talking about you having to spend more time with parents. We are talking about getting the PTA to take action in some of the programs in school. You know, move away from fund-raising activities; get into talking about the importance of math and science and to put on programs for parents and that kind of thing. Those are just examples.

So if we can build this kind of a system and we can establish some good models for building that system within science and math, that is going to feed up and change the total school complex because of the discipline regardless of what you are teaching need a support system.

You were talking about—I heard some very important things. We are talking about connecting our teachers through Virginia Pen with a computer—computer networking. We are going to go to industry and ask them to support that kind of an enterprise. But, you have got to have a telephone line into your classrooms in order to get that done. That is why some of our meetings have got to involve administrators, school boards and people like that. We can no longer continue to talk to ourselves. We have got to talk people outside the picture.

So what I am trying to do here is kind of summarize for you. The important thing about VQEST—remember, we have got set goals and we are going to keep those goals foremost in mind over the next several years. What we are going to work on, though, are the factors in the system which will help us achieve those goals.

And with that, I thank you for allowing me to be here today. And you are going to see us a lot in southwest Virginia because when we build these regional Action Councils, we are not going to ask you to come to Richmond; we are going to come to you. We are going to come to you in Abington; we are going to come to you in different places so that you can get your local people together. And what was that other one?

VOICE. Clinch Valley.

Dr. EXLINE. Clinch Valley, Jonesville—way out there. We are going to go out—we are going to come all the way out there. So, we will see you, Cam. I appreciate being here.

[Applause.]

Mr. TAYLOR. Okay, on behalf of Mr. Boucher and the other people involved here, we want to thank you for being here today. I

think this was a good experience for all of us, and certainly gives us a lot of things to think about.

Thanks.

[Whereupon, at 3:30 p.m., the Subcommittee was adjourned.]

APPENDIX

OPENING STATEMENT TO THE
SUBCOMMITTEE ON SCIENCE FIELD HEARING ON
EXCELLENCE IN SCIENCE TEACHING
BY THE
HONORABLE RICK BOUCHER (D-VA)

MAY 15, 1992

I want to express my appreciation to Dr. Warren of New River Community College for his hospitality in providing a forum for today's conference.

My goal this morning is to give Southwest Virginia science educators a direct voice in the federal policymaking process. I have brought the senior staff of the Subcommittee on Science to Dublin to receive your views on the state of contemporary science education. I have also asked the Assistant Director for Education and Human Resources at the National Science Foundation, Dr. Luther S. Williams to join us for this conference. Dr. Williams is responsible for the administration of our major Federal programs to improve science education.

Just three years ago, President Bush invited our nation's governors to Charlottesville for an historic Education Summit. The Summit produced six National Education Goals for achievement by the year 2000. The Fourth Goal which all of us share: by the year 2000, U.S. students will be first in the world in science and mathematics achievement.

Since becoming Chairman of the Subcommittee on Science last year, I have developed an increasing realization of the distance we must travel to achieve that goal. In a recent international science achievement survey, comparing the performance of students in the United States and other nations, American high school seniors studying "advanced placement" biology placed last out of 13 nations. Overall, American high school students performed below their counterparts in Japan, Taiwan, Mexico, Canada, and Thailand.

The problem is much deeper than just declining test

scores. In many of our nation's high schools, science courses are only electives or, in many instances, are unavailable to students. Nearly 30% of our high schools fail to offer courses in physics and 17% offer none in chemistry. Textbooks are frequently far behind the explosion of information in scientific fields. Many children will never have the opportunity to use laboratory facilities or a computer during their entire precollege education. Most disturbing is the recent report that one-half of our children conclude by grade seven that science and mathematics are not open to them as options for continued educational growth or potential future employment.

Science teachers face systemic barriers ranging from low salaries to working with outdated or inadequate instructional materials. Some teachers have never had a college-level course in the subjects they must teach. Too often science teachers are required to teach out of their fields due to local budget

pressures, and those same pressures require that they have homeroom duty, bus duty and numerous other non-instructional responsibilities.

Recognition and status for science teachers are low, and opportunities for professional advancement are often lacking. Elementary school teachers, in particular, are in some cases inadequately prepared to teach science. At the middle school and secondary school level, access to teacher preparation and enhancement programs is severely limited, as is teacher access to the scientific community.

As a result of these and other problems, many teachers are simply leaving for other endeavors. A recent report by the Office of Science and Technology Policy found that we are currently losing thirteen mathematics and science teachers for each one entering the profession.

A related problem is the need to bring about greater involvement by parents in their children's education. Parents should not expect to drop off their children in kindergarten and pick them up thirteen years later academically prepared to succeed in college and the workforce. School reform alone will not resolve the lack of preparation of K-12 students. Parents must be actively involved in the K-12 learning process, and the question of how to accomplish that is one of the issues I hope we will explore today.

A very encouraging development which we will discuss at some length later this morning is the recent award to the Commonwealth of Virginia of a $9.6 million National Science Foundation grant to improve mathematics and science education in grades K-8. The funding will be used state-wide over the next five years for a range of initiatives including in-service professional development and support for science

education through the state's telecommunications system. Plans are underway to implement the grant through ten Local Action Councils which will include Southwest Virginia. Joe Exline of the Virginia Department of Education is here today to describe the programs to be implemented under the grant and what they will mean for science teachers in Southwest Virginia.

Thirty-five years ago the link between American science education and our international competitiveness was made clear by the launch of the Soviet space satellite Sputnik. But while American preeminence in higher education in the technical areas has been maintained in the years since 1957, our standing in precollege science and mathematics education has seriously diminished. Without action on our part, this trend will seriously jeopardize our future national economic security.

Today's high school graduates are entering the most

technologically challenging environment the world has ever known. Technical literacy is already essential to a wide range of occupations, from using computers in the office to operating an automated production line.

Basic science and technology skills are also essential to America's competitive position in the global economy. We as a nation can meet this challenge and excel if we commit ourselves to the hard work and allocation of resources necessary to prepare our students for living and working in the next century.

We welcome your participation in this hearing, and look forward to your direct voice in the policy process of improving science education.

Proposals for Legislation and Concerns:

1. Class size (particularly lab size) in relation to instruction, safety and liability - and increase the actual amount of time in the classroom during the day - not necessarily the year!

2. Funding:
   A - Title money (possibly) for non-consumable items and for expendable materials.
   B - Continue with the Eisenhower funds for inservice
   C - Allow the use of the above funds in other areas in addition to inservice.

3. Computers for classrooms as well as computer classes for science teachers to utilize what is available.

4. Opportunities for enrichment both for students and teachers. Workshops, institutes, and camps. © Bring people in and © allow and fund our people to go out.

5- Pay Scale and being treated as Professionals
- We are losing quality people who might be interested in teaching, or keeping people already teaching.

6- Discipline - uniform guidelines stating expectations & discipline in all schools-

7. Mandatory Attendance - minimum number of days to get credit for a lab course-

8- Monies to pay resource people f/ both teachers and students-

9- Integrated Science Curricula K-12- and have an equal opportunity for science education for all students.

Sheem - Judy Farris
President SW VAST
Teacher in Washington Co. Schools
John S. Battle H.S.

CHATHAM HALL CHATHAM, VIRGINIA

May 4, 1992 BP #311

The Honorable Rick Boucher, Chairman
Subcommittee on Science
U.S. House of Representatives
Committee on Science, Space, and Technology
Suite 2320 Rayburn House Office Building
Washington, DC 20515-6301

Dear Representative Boucher:

Thank you for letting me know about the hearing on science education to be held in Dublin, Va. on Friday, May 15, 1992. I truly would like to attend this meeting, however, this near the end of school it is impossible.

I would appreciate having you send information about the agenda of this meeting and notices of any future meetings.

I am very concerned about science education - have been teaching for over thirty years and have taught teachers as well as secondary school students. Good science education is top priority in my book and I am glad it is in yours, too.

Sincerely yours,

D Burch

Dr. Donna Burch
Head, Science Dept.

305 Rucker Road
Blacksburg,VA 24060
April 19,1992

BP #303

Congressman R Boucher, chairman
Subcommittee on Science
US House of Representatives
Committee on Science, Space, and Technology
Suite 2320 Rayburn House Office Building
Washington, DC 20515-6301

Dear Congressman Boucher:

In my capacity of serving on the executive committee of the Virginia Tech Physics Department, I saw your letter inviting my collegue D D Long to testify before your committee on May 15,92. Your are dealing with a very important problem - science education in the USA. Only recently has it dawned on the political and business community that our young people are not as well prepared for the technological workplace as others in the industrialized world.

I doubt that I have magic solutions, but I think I see many of the problems. The natural sciences are difficult subjects to master and in general enrollments are low. Those who can graduate from college with a major in Physics, Chemistry or Biology are likely to try for more intellectually and financially rewarding careers than public school teaching. Those who go into teaching such subjects often have taken one or two college science courses at the most basic level. Compare this to what a premed student must take as the minimal requirement: calculus, physics, biology, chemistry, and organic chemistry and all the science courses with laboratory training. Of course the latter do this because of the future rewards of a medical career.

The first thing I would demand from teachers is knowledge of subject rather than education methodology. To get such people, you will not only have to increase the rewards, but better the working conditions. Teachers salaries and resources are poorly funded and the current system of deriving such funding largely through local property taxes perpetuates this phenomena, especially in poorer areas. Teachers need <u>less</u> classroom time and more time to prepare interesting lessons and properly grade papers. If these chores are forced into the night hours the quality is affected. Sure this means we need even more teachers, but we became the world's leading military power because no expense was spared.

As a university professor I'm judged every year on both my teaching and research. The latter demands that I keep up with and add to the body of knowledge in the field. In some way public school teachers should also be required to keep up with current knowledge and D D Long's program has done something about this. Public school teachers could also be judged on laboratory

experiments and demonstrations they prepare in addition to their classroom presentations. However, experiments and demonstrations require resourses, part of which could easily be transferred from technology firms to the schools; particularly if such firms are so worried about the qualifications of future employees.

Finally schools and curricula need revamping. School buildings stand mostly idle in summer months and may be over crowded during the rest of the year. Students need a safe place to study with academics rather than athletics stressed and rewarded. High quality trade schools are needed for those without the inclination to go to college. Teachers have to be released from baby sitting for students , who for whatever reason, are disaffected from basic societal norms. Schools should get away from 45 minutes of science per day. Perhaps on Tuesday and Thursday the science classes integrated with laboratory work could run for 2.5 hours so that a sustained effort could be carried out. Perhaps even the weekend could be so utilized.

I wish you and your committee good luck. People pay the problem alot of lip service, but where are those willing to change their life styles just a little in order to effect a solution.

Sincerely yours,

Marvin Blecher

Marvin Blecher

April 21,1992

Representative Rick Boucher
Committee on Science, Space, and Technology
Suite 2320 Rayburn House Office Building
Washington,D.C. 20515-6301

Dear Mr. Boucher,

I recently received your letter concerning a field hearing on excellence in science teaching to be held at New River Community College on May 15,1992. It sounds like a wonderful opportunity for area educators to share concerns and solutions to the dilemma of preparing our students to be competitive in math and science on a world class scale. I, unfortunately, will be unable to attend this hearing as I'll be chaperoning an eighth grade trip to Washington,D.C. that weekend. I was very disappointed when I realized I had a conflict. Despite my inability to attend this gathering I would like to receive any written information that may be generated at the hearing. I am very interested in issues concerning science and technology and have been actively involved in a funded project at Virginia Tech (Reading to Learn in Science Education) for the past three years. This project was funded for Dr. Rosary Lalik and Dr. George Glasson by the Virginia Department of Education and has resulted in a great many educators being introduced to alternative ways to teach science in elementary, middle and high schools. I have also worked with Dr. Dale Long at the Virginia Tech Physics department. He has been very helpful over the years in helping me make Physics more relevant to my students. Recently I have become involved in Technology applications in the classroom and am working with another teacher in bringing Hypercard programming to our students through the use of Macintosh computers. We have presented a proposal to our school officials to try to expand this program should funds become available.

I appreciate your support for education in Virginia and in particular your interest in isssues and answers in science education. Please consider me for any future forums and committees that may fall into this category. I believe educators can only make changes if they are informed and involved in the decision making process.

Sincerely,

Suzan W. Mauney

Route 1, Box 657
Wise, VA 24293
April 21, 1992

Congressman Rick Boucher
Subcommittee on Science
Regional Office
Big Stone Gap, VA

Dear Congressman:

I was pleased to learn of your work on a committee which has science education as a focus. The scheduled hearing should help considerably in your development of a perspective regarding the current problems. I look forward to attending. Since I have some thoughts which have been forged over a relatively long period of work "before the mast" in education and since the expression of these thoughts require a bit more organization than I can be confident of mustering at the meeting, this note is for your consideration.

I have taught sciences at Hays, Martinsville, and Wise (including chemistry, biology, earth science, advanced placement science, physics and general science). I have worked as assistant principal, administrator of Title IVC gifted/talented program, and middle school principal. Evening and summer work have included teaching biology in junior college, teaching adult basic education in prison camp, teaching a gifted/talented education class for UVa extension, and directing the Youth Conservation Corps program on The Jefferson National Forest.

When I decided to return to classroom teaching, the assignment was one of teaching science to students who have apparently had little academic success in the past and in general appear to have no interest in learning. Most do not read text material nor do they cooperate voluntarily when explanations and demonstrations are attempted. As a teacher who is skilled in motivation techniques, I find the situation frustrating. More troubling is the conviction that half of my students could realize significant degrees of science literacy if I were able to instruct them in the absence of the trouble makers. We seem to have no mechanism for accomplishing this task.

It seems to me that the federal government can insure improved education by supporting the notion that all students must accept responsibility for the well being of the school as a requirement of attendance in the regular program. Our many "support" programs contribute in subtle ways to a negative attitude through gifts to students that carry no reciprocal efforts. Federally supported summer skill development jobs often go to students who have a history of distruction of school property. I see no evidence that responsible behavior follows gifts. A lack of respect for our institutions and for government in general seems to follow. Those who don't feel responsible for their own learning do not learn, nor are they caused to learn by the many forms of "assistance" that we conjure up. Our efforts toward dropout prevention and enforcement of compulsory attendance laws harm ordinary students when these efforts are not coupled with standards of behavior that protect the learning environment. In no discipline does school disruption have a greater effect on conceptual development than in science.

Sincerely,

Jack C. Turner

Jack C. Turner

U. S. House of Representatives
Committee on Science, Space and Technology
Subcommittee on Science

SCIENCE TEACHER CONFERENCE/WORKSHOP
New River Valley Community College
May 15, 1992

1. Dr. Larry Howdyshell
Supervisor of Secondary Education
Montgomery County Schools
200 Junkin Street
Christiansburg, Virginia 24073

2. Dr. James L. Ruffa
Director of Secondary Education
Montgomery County Schools
200 Junkin Street
Christiansburg, Virginia 24073

3. Mr. Michael Wright
Superintendent
Radford City Schools
P.O. Box 3698
Radford, Virginia 24143

4. Charles K. Jervis
Auburn High School
4163 Riner Road
Riner, Virginia 24149

5. Jack C. Turner
J. J. Kelly High School
Route 1, Box 657
Wise, Virginia 24293

6. Mr. Ed Sutphin
Virginia Dept. of Education
Regional Services Representative
Clinch Valley College
Wise, Virginia 24293

7. Ms. Vicki Fletcher
Rhea Valley Elementary
P.O. Box 222
Damascus, Virginia 24236

8. Ms. Cecila G. Ross
Roanoke County Schools
3712 Chaparral Drive
Roanoke, Virginia 24018

9. Ms. Bonita M. Kelley
Roanoke County Schools
2524 Churchill Drive, NW
Roanoke, Virginia 24012

10. Prof. Dale D. Long
Department of Physics
Virginia Tech
Blacksburg, Virginia 24061-0435

11. Mr. Tom Morris
Montgomery County School System
4543 Pilot Road
Pilot, Virginia 24138

12. Ms. Judith Holland
Rye Cove High School
Route 4, Box 154
Clinchport, Virginia 24244

13. Ms. Joy E. Colbert
Director of Research & Development
Pulaski County School System
44 Third Street
Pulaski, Virginia 24301

14. Mr. Michael Braswell
Bristol, Virginia School Board
130 Crossway
Bristol, Virginia 24201

15. Mr. Peter J. Mursak
Virginia High School
Long Crescent Drive
Bristol, Virginia 24201

16. Mr. Jack Mason
Earth Science Teacher
Marion Senior High School
Route 2, Box 263
Meadowview, Virginia 24361

17. Mr. John H. Fesperman
250 Starmont Boulevard
Danville, Virginia 24541

18. Ms. Katherine Brennan
Science Teacher
Auburn Middle School
4462 Sidney Church Road
Riner, Virginia 24149

19. Mr. Larry Bond
Assistant Superintendent
Wythe County School System
1570 W. Reservoir Street
Wytheville, Virginia 24382

20. Ms. Judy T. Fanis
President, SWVAST
500 Ridgecrest Drive
Abingdon, Virginia 24210

21. Ms. Lydia Hucks
Washington County School System
Route 1, Box 276
Meadowview, Virginia 24361

22. Ms. Cathy Hurst
5th Grade Science Teacher
Roanoke County School System
2720 Stephenson Avenue
Roanoke, Virginia 24014

23. Mr. Robert G. Cobb
Pulaski County School
89 Howell Drive
Dublin, Virginia 24084

24. Ms. Suzanne Plaza
Roanoke City Schools
2619 Guilford Avenue, SW
Roanoke, Virginia 24015

25. Dr. Timothy Pickering
Professor of Chemistry
Virginia Tech
201A Hancock Hall
Blacksburg, Virginia 24061-0257

26. Mr. Howard Spencer, Coordinator
Science and Technology Project
Giles County School System
507 Wenonah Avenue
Pearisburg, Virginia 24134

27. Ms. Ellen Hartracker
Giles County School System
Route 1, Box 52
Pearisburg, Virginia 24134

28. Ms. Darlene Cunningham
Giles County School System
Route 1, Box 52
Pearisburg, Virginia 24134

29. Ms. Jennifer Stuart
Giles County School System
Route 1, Box 52
Pearisburg, Virginia 24134

30. Mr. Neil Schmidt
Giles County School System
Route 1, Box 52
Pearisburg, Virginia 24134

31. Mr. Bob McCracken
Superintendent of Schools
Giles County School System
Route 1, Box 52
Pearisburg, Virginia 24134

32. Dr. Joe Exline
Va. Department of Education
P.O. Box 6Q
Richmond, Virginia 23216

33. Ms. Karen Hines
Radford High School
50 Dalton Drive
Radford, Virginia 24141

34. Mr. Gary Schafer
Radford High School
1755 Bishop Road
Blacksburg, Virginia 24060

35. Ms. Mary Norris
Radford High School
50 Dalton Drive
Radford, Virginia 24141

36. Dr. Joe Berry
Carroll County School System
P.O. Box 1328
Hillsville, Virginia 24343

37. Ms. Lisa Driscoll
Carroll County School System
P.O. Box 1328
Hillsville, Virginia 24343

38. Ms. Nancy Gamble
Director of Secondary Education
Bland County Schools
P. O. Box 339
Bland, Virginia 24315

39. Ms. Julia Grady
Montgomery County School System
P.O. Box 29
Christiansburg, Virginia 24073

40. Ms. Karen Langebeck
Montgomery County School System
P.O. Box 29
Christiansburg, Virginia 24073

41. Ms. Susan Foard
Physics Teacher
Roanoke City Schools
2633 Edgewood Street, SW
Roanoke, Virginia 24015

42. Ms. Connie E. Turner
Christiansburg Middle School
208 College Street
Christiansburg, Virginia 24073

43. Mr. John E. Allgauer
Science Teacher
Roanoke County School System
39 Frederick Circle
Hardy, Virginia 24101

44. Ms. Diana Atkinson
Christiansburg Middle School
360 Mulberry Drive
Christiansburg, Virginia 24073

45. Mr. Richard W. Shelly, Director
Roanoke Valley Governor's School
2104 Grandin Road, SW
Roanoke, Virginia 24015

46. Mr. Al Able
Smyth County School System
P.O. Box 987
Marion, Virginia 24354

47. Ms. Janice Orr
Smyth County School System
P.O. Box 987
Marion, Virginia 24354

48. Mr. Rom Matlock
Giles County School System
Route 1, Box 52
Pearisburg, Virginia 24134

49. Mr. Ron Skeens
Giles County School System
Route 1, Box 52
Pearisburg, Virginia 24134

50. Ms. Sarah Wheeler
Giles County School System
Route 1, Box 52
Pearisburg, Virginia 24134

51. Mr. Harvey Atkinson
Rural Retreat High School
Rural Retreat, Virginia 24368

52. Ms. Carol Watson
Sheffey Elementary School

53. Mr. Stewart Colley

54. Ms. Maxine Morris
Floyd County High School
220 New Town Road
Floyd, Virginia 24091

55. Ms. Freda Rorrer
Floyd County High School
220 New Town Road
Floyd, Virginia 24091

56. Ms. Rebecca Williams
Mount Rogers Combined School
P.O. Box 219
Independence, Virginia 24348

57. Mr. Bob Giles
Cave Spring Junior High
4880 Brambleton Road
Roanoke, Virginia 24018

58. Ms. Suzy Wire
Cave Spring Junior High
4880 Brambleton Road
Roanoke, Virginia 24018

59. Pat Woods
Northside Senior High
6758 Northside High School Road, NW
Roanoke, Virginia

60. Ms. Kathy Hurst
Green Valley Elementary
3838 Overdale Drive, SW
Roanoke, Virginia

61. Ms. Ginny Basham
Mt. Pleasant Elementary
3216 Mt. Pleasant Boulevard
Roanoke, Virginia

62. Ms. Gayle Ross
Cave Spring High School
3712 Chaparrel Drive, SW
Roanoke, Virginia

63. Ms. Rebecca Hancock
Roanoke County Career Center
100 Highland Avenue
Vinton, Virginia

64. Mr. Richard Kelly
William Byrd High School
2902 Washington Avenue
Vinton, Virginia

65. Ms. Bonnie Kelly
Cave Spring High School
3712 Chaparral Drive, SW
Roanoke, Virginia

66. Ms. Vicki Williams
Biology and Chemistry
Powell Valley High School
1 Avenue of Champions
Big Stone Gap, Virginia 24219

67. Ms. Debra Artrip
Earth Science and Biology
Powell Valley High School
1 Avenue of Champions
Big Stone Gap, Virginia 24219

68. Ms. Mary Litts-Burton
Director of Instruction
Alleghany Highlands Schools
110 Rosedale Avenue
Covington, Virginia 24426

69. Mr. Fred Merica
Science Teacher
Alleghany Highlands Schools
110 Rosedale Avenue
Covington, Virginia 24426

70. Mr. Dave Peters
Science Teacher
Alleghany Highlands Schools
110 Rosedale Avenue
Covington, Virginia 24426

71. Ms. Rebecca Wilkinson
Science Teacher
Northwood High School
Drawer Y
Saltville, Virginia 24370

72. Dr. Myrl Allen, Jr.
General Supervisor
Russell County School System
P.O. Box 8
Lebanon, Virginia 24266

73. Ms. Dianne Cornelison
Chairman, Science Department
Campbell County School
Route 4, Box 278A
Lynchburg, Virginia 24503

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